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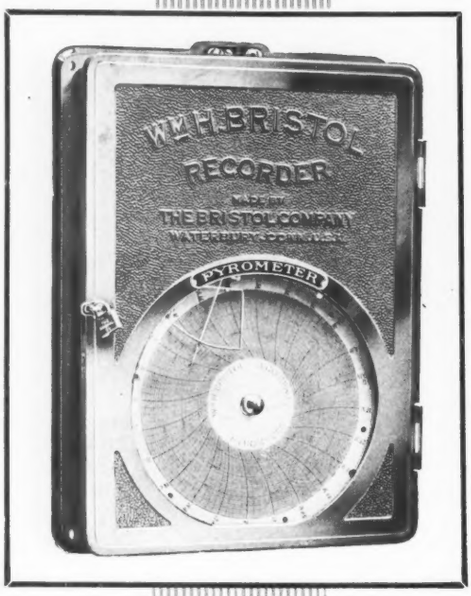


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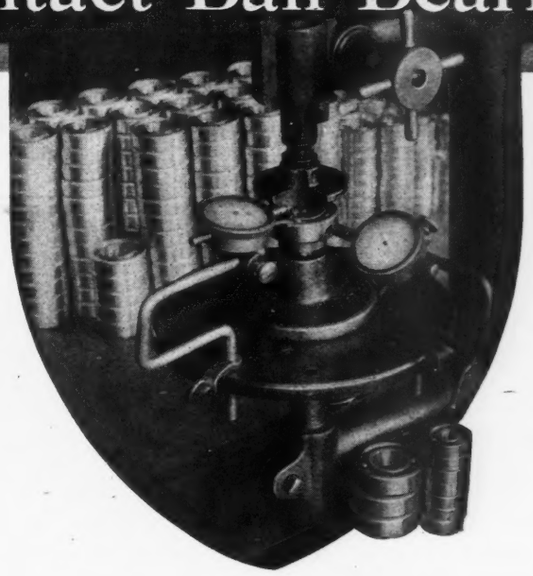
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Manufacturing Three-area Contact Ball Bearings



A Detailed Description of the Manufacturing, Inspection, and Assembling Methods Used in the Shops of the Federal Bearings Co., Inc., Poughkeepsie, N. Y., in Producing Three-area Ball Bearings

First of Two Articles

By FRED R. DANIELS

THE development of the three-area contact annular ball bearing is in no sense an attempt to change established practice in ball-bearing design, but rather to augment the efficiency and adaptability of the ball bearing to meet present-day requirements. It is claimed by the manufacturers of this type of bearing, the Federal Bearings Co., Inc., Poughkeepsie, N. Y., that in this product there are incorporated features of construction and design which make for severe service, increased efficiency, and high thrust capacity; in fact, a thrust capacity, in either direction, of 50 per cent of the rated radial capacity is claimed, due mainly to the three-area contact feature of the bearing.

In order that this characteristic may be thoroughly understood at the outset, so that it will not become confused with the three-point cup-and-cone design which is fast being superseded by annular bearings, attention is directed to the sectional view of the bearing, Fig. 1, in which the relation of the contact areas is indicated. It will be seen that the bearing consists of an inner race ring *A* having a rather deep annular groove in which a single row of balls is arranged. The balls contact in two outer race rings *B*, the included angle being 28 degrees as indicated in the illustration. The curvature of the three contact surfaces, in both inner and outer race rings is 4 per cent greater than that of the balls. A cage or ball separator consisting of two interlocking retainers, as shown at *C*, partially encloses the balls, the whole being contained in an outer case *D*.

The very term "three-point contact," or more properly "three-area contact" makes it difficult for the engineers of the Federal Bearings Co. to convince the users of ball bearings as to the claims which are made for this design, for, in general, the use of three-point bearings is not popular. This is no doubt due to the tendency, in the original three-point design, of the balls to wear down the cone, particularly under thrust load, causing them to bind and cease to function properly. In the bearing here described, however, the three contacts are obtained in an annular bearing, using but one line of balls, and consequently the objectionable feature of the cup-and-cone type of bearing as just cited, cannot obtain. While it is claimed by some that a four-area contact bearing is the ideal arrangement for ball bearing design, the expense which has always attended the manufacture of bearings of this type, as well as the unsatisfactory results obtained by their use in the past, has resulted in the commercial use of these bearings being superseded by bearings of more simple design and greater manufacturing facility. The three-contact design is of standardized specifications, meeting the requirements established for ball bearings by the Society of Automotive Engineers.

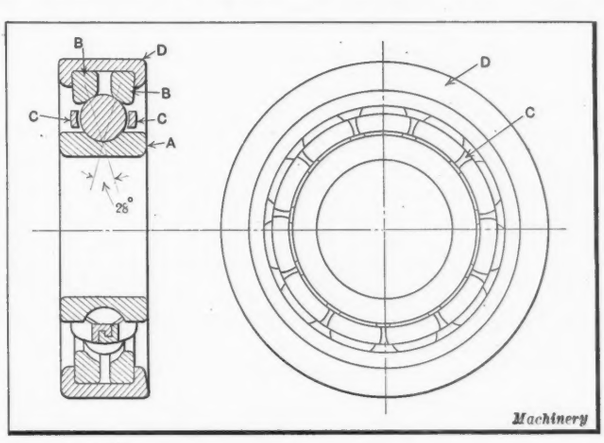


Fig. 1. Sectional View of Three-area Contact Ball Bearing, showing Relation of Parts

Making the Ball Bearing Case

The bearing case or jacket in which the various parts of the bearing are enclosed is made of open-hearth cold-rolled steel, and is blanked cold from sheet stock on a power press equipped with standard construction blanking dies. The second operation consists of drawing to the proper depth, and the third operation is that of punching out the center of the shell. The inside diameter of the case is next sized, this work also being done on a power press equipped with a plain cylindrical punch. The cases are next slightly chamfered on both outer edges and both sides of the pierced hole, as shown in the sectional view in Fig. 1. Except for the final truing up and grinding operations, and the operation of closing the case and removing burrs resulting from this operation, all of which is done after the bearing has been fully assembled, this concludes the machine work on the case. In the manufacture of smaller sizes of bearings which may

be used as rollers, it is necessary to harden the case, but otherwise this treatment is not required.

Operations on the Race Rings Prior to Heat-treatment

The inner race ring *A*, Fig. 1, is roughed out from solid bar stock or sometimes from heavy steel tubing, on Cleveland or National Acme automatic screw machines. The stock from which the rings are made is a high-carbon chromium steel having the following special analysis: Carbon, 1.15 to 1.30 per cent; phosphorus and sulphur, less than 0.02 per cent each; manganese, 0.30 to 0.45 per cent; chromium, 1.15 to 1.30 per cent; and a trace of vanadium. Following the roughing out operation on the automatic in which the ball race or groove is also rough-turned, both sides of the ring are chamfered inside and out, after which the parts are ready for heat-treatment.

The outer race rings are made from a special chrome-vanadium alloy steel of the following composition: Carbon, 0.95 to 1.10 per cent; phosphorus and sulphur, less than 0.2 per cent each; manganese, 0.45 to 0.60 per cent; silicon, 0.10 to 0.20 per cent; chromium, 1.00 to 1.10 per cent; and vanadium, 1.15 to 1.20 per cent. The rings are not made from solid stock, but are blanked out cold from sheet metal, and after being subjected to two press operations are forged to the approximate section shown in Fig. 1 at *B*. The second press operation consists of cupping or drawing the blank, a production rate of from 10,000 to 12,000 pieces per day being maintained on the average size blanks. The center holes are next punched out, leaving a flange at the bottom of the shell, after which the parts pass to a gas furnace where they are heated from 1450 to 1475 degrees F., and they are then forged to shape. This is evidently the most satisfactory method of producing the rings, eliminating many machine operations and much wastage of stock which would be required to produce the parts from bar or tube stock on the automatics. The rings are next annealed and then pickled to remove the oxide scale and dirt, after which they are ready to be shaved on the inside diameter. This operation removes surface defects such as might be produced in forging, and is performed on a turret lathe or hand screw machine, the rings being held in a suitable chuck while the operation is being performed.

Heat-treating the Rings and Testing for Hardness

Both the inner and outer rings are subjected to essentially the same heat-treatment, which is carefully performed in the heat-treating department, a view of which is shown in Fig. 2. On the right-hand side of the room will be seen a battery of Frankfort oil-burning furnaces, manufactured by the Strong, Carlisle & Hammond Co., while at the left of the room may be seen a hardening furnace, also one water and one oil quenching tank. The heat-treatment consists of normalizing the parts at a temperature of from 1450 to 1475 degrees F. in the heat-treating furnaces shown in the illustration, the heat being regulated by individual pyrometer control. After cooling, the rings are reheated to the decalescence point (1450 to 1475 degrees F.) in the hardening furnace and quenched.

Fig. 4 shows a view of the water quenching tank to which attention has been called in connection with the reference to Fig. 2. A special quenching device is shown, which is used in hardening the outer race rings only. They are placed in this holding arrangement *A*, which is conveniently attached to the side of the tank and quickly immersed in the water. This special provision in connection with the even temperature of about 65 degrees F. maintained by circulating the water, prevents the rather slender rings from warping and assures an even hardness. The holding device is attached to the side of the tank in such a way as to permit a stirring movement when immersing it, and a weighted arm prevents it from dipping into the bath while the handle is being operated, during the operation of putting the hot rings in place. The inner race rings are quenched in oil instead of in water, and the tank in which they are quenched is provided with coils for the purpose of circulating the oil and maintaining an even temperature throughout the bath. This oil quenching tank may also be seen in Fig. 2.



Fig. 2. View of the Hardening Department, showing Battery of Heat-treating Furnaces and Quenching Tanks

After hardening, all rings are tempered in oil at 350 degrees F., and then subjected to a file hardness test. It has been the experience of the engineers of the company, that more satisfactory results can be obtained by using the file test than by either the Brinell or scleroscope methods. The testing department in which the rings are tested is situated at the farther end of the hardening room, which enables the heat-treating and testing departments to work in close co-

operation. Warpage defects are here also carefully looked for, the rings being tested on a surface plate.

Finishing Operations on the Inner Ring prior to Assembling the Bearing

In the manufacture of high-grade ball bearings many types of grinding machines are used. Besides employing grinders of standard construction, satisfactory results are obtained by using a special radial grinder designed by the company, a sectional view of which is shown in Fig. 3. It will be seen that the design of the machine is simple, consisting of a grinder-head *A* and a work-head *B*, both of which are driven independently. The work-head is capable of swinging on post *C* and is provided with suitable means for regulating the length of radius when setting up the machine.

The first operation on the inner race ring after heat-treatment is performed on a Blanchard grinder, both sides being ground to very close limits. The rings are next ground on the bore, an operation which requires very accurate workmanship, the tolerance on certain sizes being as close as plus 0.0002 inch and minus 0.0003 inch. This operation is performed on Heald, Bryant, and Van Norman internal grinders. After being ground the work is carefully inspected, and no rings are permitted to be passed along if they are bell-mouthed, tapered, or not within the tolerance limits.

In grinding the raceway in the inner ring, a radius 4 per cent greater than that of the balls which are to be assembled in this groove, is produced. This operation is shown in Fig. 6, the machine employed being of the special design previously mentioned and shown in Fig. 3. It is equipped with an arrangement for testing the diameter of the groove and also the running truth of the grinding machine arbor. This is accomplished by means of suitable lever arms *A* and *B* in which diamond points are carried, which are brought in contact with the work from time to time as the rings are being ground. The very accurate limits to which the raceway is held are determined by an Ames indicator, which is plainly shown in the illustration. The indicator is graduated to read to 0.001 inch, and the lever arm ratio is 10 to 1, so that each 0.001 inch on the dial will indicate a change of 0.0001 inch in diameter or in running truth, according to which diamond point is in contact with the work.

During the final operation on the inner rings before assembly, the raceways are lapped, the work being done on a speed lathe as illustrated in Fig. 5. A lapping compound consisting of wax, tallow, and flour emery is used, and a special lead lap employed which is secured in tong-like holders as shown. The illustration also shows a number of rings mounted on an arbor, and the lapping operation being performed. The rings are then cleaned in soda and sent to the inspection department.

Finishing Operations on the Outer Race

After being subjected to the hardness test in the heat-treating department, the outer race rings are ground on the side, the parts being held on the magnetic chuck of a Blanchard grinder, equipped with a measuring arm and an Ames dial indicator, as clearly shown in Fig. 7. By this means the limits to which the work is held may be quickly and accurately obtained. After grinding, the rings are cleaned by compressed air at 80 pounds pressure. It will be apparent, as the chips adhere to the rings due to the magnetism produced in the grinding operation, that the only satisfactory way to clean the rings is with compressed air.

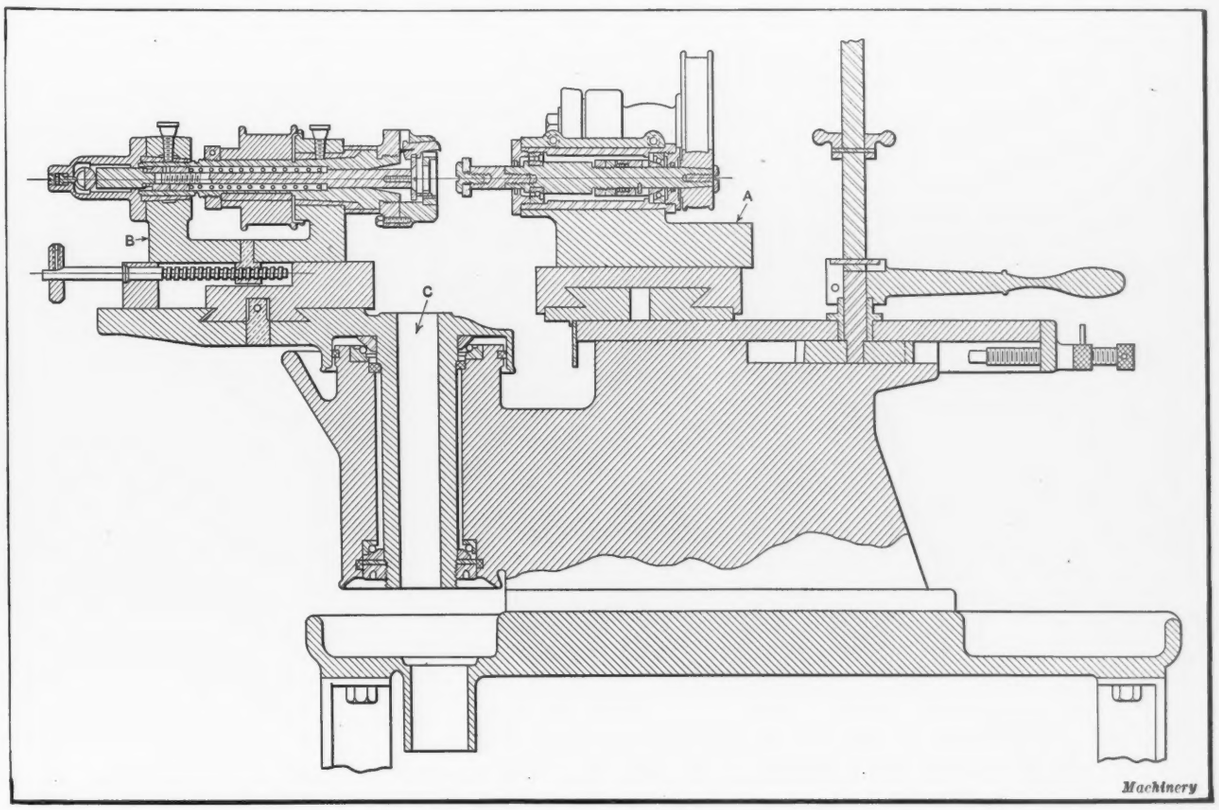


Fig. 3. Sectional View of Specially Designed Radial Grinding Machine used in grinding the Race Rings

The parts are next demagnetized on a Walker demagnetizing machine, after which they are ground on the outside diameter. During this operation the rings are mounted on an arbor in either an Ott or a Norton cylindrical grinder provided with a dial indicator and measuring arm as shown in Fig. 8. This illustration shows the operation very clearly, although the diamond point which is kept constantly in contact with the surface being ground, and which is held in the opposite end of the measuring arm, cannot be seen. The leverage of the measuring arm has a ratio of 10 to 1 so that readings within 0.0001 inch are obtainable.

The radial grinder shown in Fig. 9 is fitted with an automatic calibrating device, which gages the accuracy of the ball track location during the process of grinding the contact surface in the outer race ring. This calibrating device is similar to those employed on previous grinding operations,

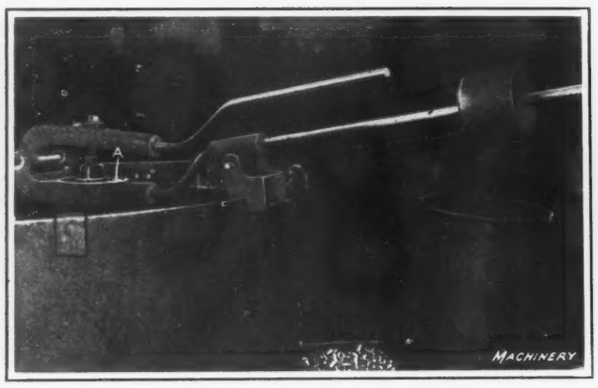


Fig. 4. Device in which the Hot Outer Rings are held when being quenched as a Means of preventing Warpage

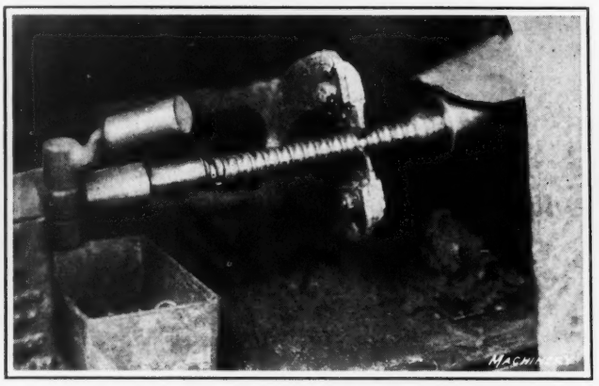


Fig. 5. Lapping the Raceways in the Inner Rings on a Speed Lathe, the Laps being held in a Special Holder

and consists of a lever-arm arrangement with a dial indicator on one end and a diamond point which is held in a suitable pivoted arm and which is brought in contact with the race ring from time to time during the process of grinding. This is accomplished by the thumb-lever arrangement shown. As in other grinding operations performed on both the outer and inner race rings, the established limits of accuracy are maintained. It has already been mentioned that much of the radial grinding work performed on these parts is done on machines of special design, although the great amount of grinding necessary on these ball bearing parts has resulted in the use of a large number of machines of various standard types. The raceways are next lapped, using a lead lap and a lapping compound composed of wax, tallow, and flour emery, the operation being similar to that employed in lapping the raceway of the inner ring. Before passing to the inspection bench, the outer rings are cleaned in the same manner as the inner rings.

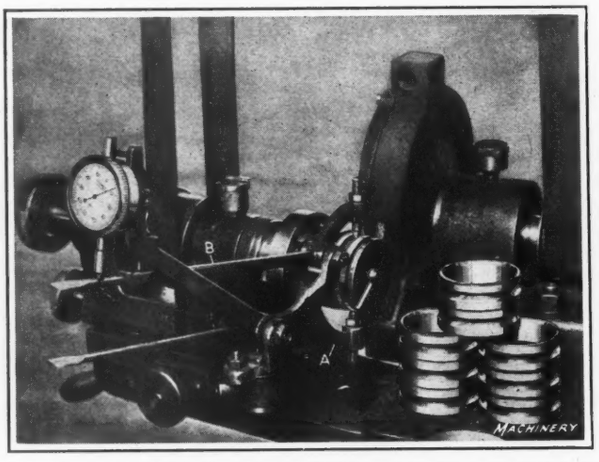


Fig. 6. Grinding the Raceway of the Inner Ring. A Special Calibrating Device is used to obtain the Required Accuracy

The cage or separator which encloses the balls in the bearing is shown at *C*, Fig. 1, from which an idea of the relation which it bears to the ball in the assembly may be had. However, the construction of the cage can more clearly be seen by referring to Fig. 10, which also shows the various stages of manufacture required in producing the two members or retainers of which the cage is composed. At *D* in this illustration the cage is shown assembled, that is, locked together. This arrangement is a distinctive feature of the cage, and as a result no rivets or similar means of holding the two parts together are required. The lugs on the mating members are so shaped that they will interlock. The advantage derived from this arrangement will be more fully apparent by a description of the assembling process.

The retainers are made from ordinary sheet metal and are blanked out and formed during a series of punch press operations. No heat-treatment or finishing operations are required, as the purpose of the cage is simply to provide a sufficiently flexible arrangement to accommodate the variations in load and changes in the axes of rotation in the balls when thrust loads are applied, and at the same time, by means of the interlocking lugs, to do away with the separate distance pieces between the balls, sometimes employed in ball bearing construction.

The first press operation on the outer retainer ring, that is, the ring in which the lugs are formed on the outside, consists of perforating and blanking, the work being done in one operation. The appearance of the stock after this operation is shown at *A*, while the shape of the part after the next operation is shown at *B*. It will be seen that in producing this shape a simple blanking operation was performed on the stock shown at *A*. The third operation is that of bending the outer lugs at right angles to the face of the ring as shown at *C*, and the final press operation produces the finished retainer. This is a forming operation in which the spaces between the lugs are shaped to the required curvature, and at the same time the lugs are given the final

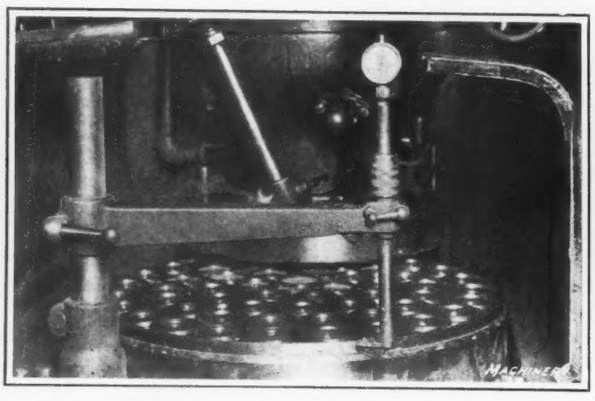


Fig. 7. Grinding the Sides of the Outer Race Rings on a Blanchard Grinding Machine

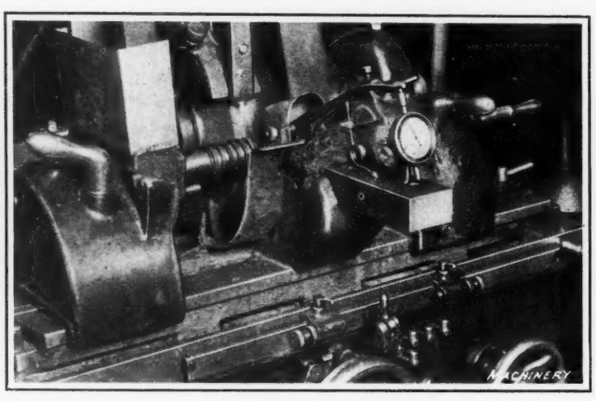


Fig. 8. Grinding Outside Diameter of Outer Race Rings on an Ott Cylindrical Grinding Machine

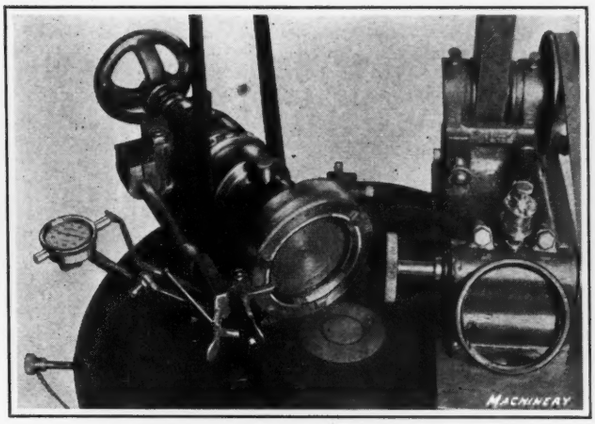


Fig. 9. During the Grinding Operation on the Outer Ring Track a Gaging Device is employed in which a Diamond Point is held in Contact with the Work

90-degree bend toward the center. In producing the inner member of the cage the work is first blanked, and then perforated, which gives it the appearance shown at *F*. The center is next punched out as at *G*, after which the internal lugs are formed at right angles to the face, as indicated at *H*. The final forming operation is similar to that employed on the outer member of the cage, and produces a retainer having internal rather than external interlocking ledges.

Owing to the large variety of bearing sizes which are in commercial use, the making of these retainers requires an elaborate outlay of dies in order that these conditions may be met. This means, of course, the employment of a great number of power presses and an extensive tooling equipment for each. The collection of parts shown in Fig. 10 constitutes a set of samples, and similar sets of every bearing manufactured are kept on file in suitable cabinet compartments,

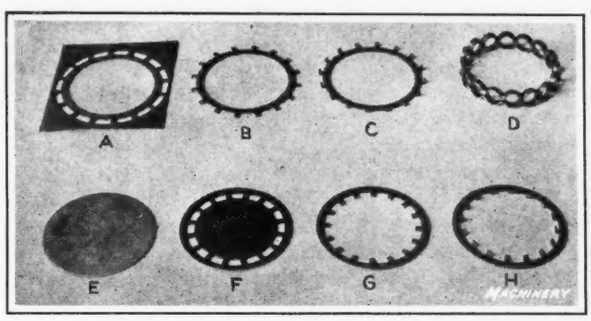


Fig. 10. Various Stages in manufacturing the Mating Retainers of the Ball Cage

together with the punches and dies employed for each individual size. For instance, the samples shown in the illustration are complete for bearing No. 212.

The second article, which will be published in the September number of MACHINERY, will deal with the inspection methods used in the plant of the Federal Bearings Co., and will describe the assembling process, as well as the final testing and truing operations.

* * *

The Ordnance Department has established a staff of trained engineers whose function it will be to study the technical problems of the Ordnance Department that seem worthy of development. Doubtless such a staff will be able to advise upon many problems where the individual engineer in charge of certain work would be unable to arrive at accurate conclusions, due to the limited time that he will have for considering all the problems encountered in his daily work.

HINGED JIG FOR DRILLING AND TAPPING

By F. SERVER

An iron casting of rather frail construction on which there are no finished surfaces is shown in Fig. 1. The only machine work required on this part is the drilling and tapping of two holes as indicated at *X*. The jig employed to hold these parts is illustrated in Fig. 2. This jig is of rather simple construction; it is of the hinged-cover type, provided with suitable means for clamping the work. On the cast-iron base *A* are two lugs by means of which the cover *B* is hinged. The cover is made from a steel forging and contains two drill bushings *C* and *D* of suitable size for guiding the tap drills. When the jig is opened, the cover may be swung back until the lug *E* comes in contact with stop *P*,

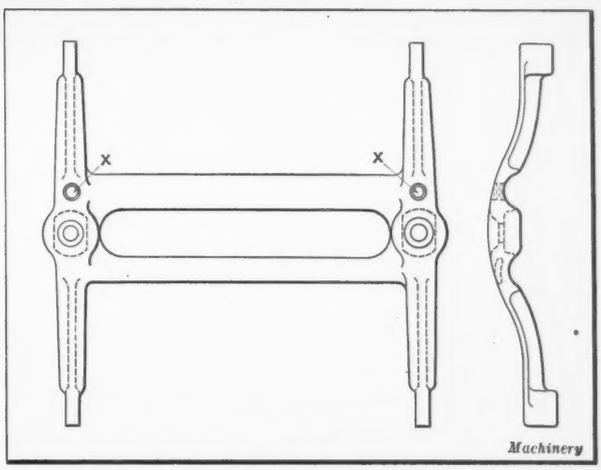


Fig. 1. Iron Casting of Frail Construction which is drilled and tapped in the Jig shown in Fig. 2

so as to prevent it from dropping back more than 30 degrees from the vertical. When the cover is closed, it rests against the studs *M* and *L*. Stud *L* also serves as a stop against which the work is abutted and secured by means of the eccentric cam *J*, located at the opposite end of the jig and operated by the pin *K*. The partial view illustrates the arrangement very clearly, from which it will be seen that the saw teeth in stud *L* prevent the work from lifting from its seat after the cam *J* has been operated to bind it in place.

It will be apparent that the casting rests on the lugs or seats *F*, *G*, and *H* and that these seats are formed on the base of the jig to conform to the shape of the casting. Studs *M* and *L* are a drive fit in the base, while the eccentric cam *J* is held in place by means of a screw and washer *N*. After the holes have been drilled, the cover is swung back and the holes are tapped without disturbing the work. It is in this connection that the rather novel method of clamping the work in place becomes of special value. The jig may be quickly loaded, and for the class of work for which it is used, the results are sufficiently accurate.

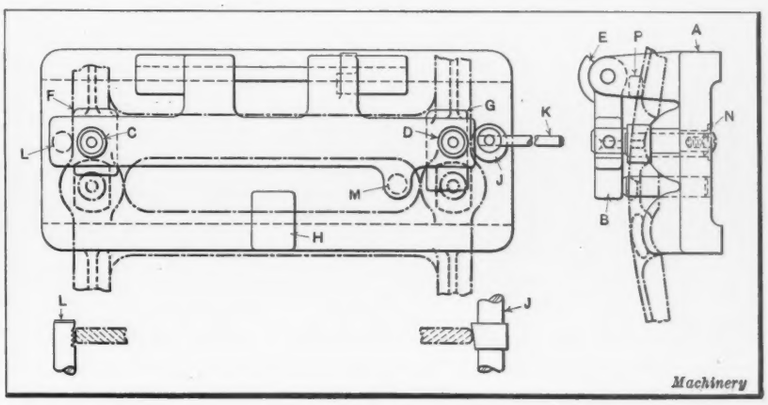
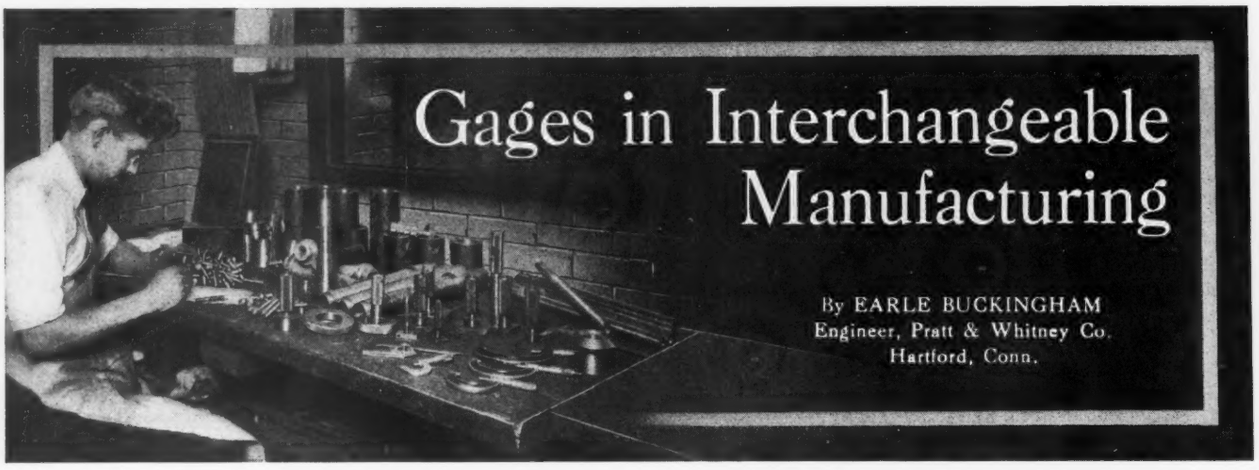


Fig. 2. Hinged-cover Drilling and Tapping Jig with Eccentric Cam Clamping Arrangement



Gages in Interchangeable Manufacturing

By EARLE BUCKINGHAM
Engineer, Pratt & Whitney Co.
Hartford, Conn.

Second of Two Articles Describing Various Types of Gages and Gaging Devices Employed in Manufacturing Interchangeable Parts

IN the first article dealing with gages in interchangeable manufacturing, which appeared in the July number of MACHINERY, attention was called to the necessity for gages in economical interchangeable manufacturing, a classification was given of gages according to their use, the required accuracy of gages and the desired relation between working and inspection gages were dealt with, and in addition, snap gages, ring gages, plug gages, contour or profile gages, flush-pin gages, and sliding-bar gages were described. In the present article it is proposed to deal with flat depth and length gages, hole gages, thread gages, wing gages, indicator gages, functional gages, and gear gages, and to present a general discussion on the subject of master gages and reference gages.

Flat Depth and Length Gages

A simple type of templet gage to measure the depth of a counterbored hole is shown in Fig. 21. One step is used as a "Go" gage, while the other is used as a "Not Go" gage. A similar gage can be used for measuring the length of a shoulder. Fig. 23 illustrates a length gage, on which the limits are indicated by scribed lines. This type is really a special scale for measuring certain fixed dimensions.

Hole Gages

A "hole gage" is a gage for testing the location of holes relative to each other or to a specified register point. The gages measure the distances between the outer and inner points of the peripheries of the holes. They are, in effect, functional gages. While the gage does not actually measure the center distances, it will insure that the accepted parts may be assembled properly. When designing such gages, the functional conditions of the mating parts must be carefully checked and analyzed to insure that the results desired will be secured without imposing unnecessary hardships on the manufacturing departments. Attention is called to the previous discussion of these conditions under the sub-head "Dimensioning of Holes" in the article on component drawings, published in the December number of MACHINERY.

This type of gage comprises an almost infinite number of designs. Some may be simple templets with studs or bushings and plugs, while others may be almost duplicates of the drill jigs used in producing the holes, using plugs through the bushings instead of drills and reamers. In fact, if the drill jig is not in constant use, and is kept properly checked, the addition of suitable plugs will make it an extremely effective gage. A few examples of gages of this type will be illustrated to indicate their wide variety. In Fig. 22 are shown two hole gages with their plugs. These are used for testing the locations of the holes in the end of the transmission case dealt with in the articles on interchangeable manufacturing equipment published in the May and June numbers of MACHINERY. They are examples of the simplest type of hole gages.

A more elaborate gage for the same transmission case is shown in Fig. 24. The holes in the shifter cover face of the work are tested with this gage for their relation to each other and to the main shaft. The transmission case is centered on the arbor and clamped by the hollow plug *A*. The stud *B* locates the case radially. The plate *C* is placed on the shifter cover face, and is located from the central arbor by forks *D* on the plate fitting in the grooves *E* on the arbor. The small plug *F* is then used to test the locations of the six small holes in the shifter cover face. At the left in Fig. 25 is shown a hole gage unloaded, and at the right, the same gage is shown with the work in the gaging position. This gage is a duplicate, in its general design, of the jig that is used when drilling the holes in the shifter cover face.



Fig. 21. Simple Type of Templet Gage employed to measure the Depth of a Counterbored Hole

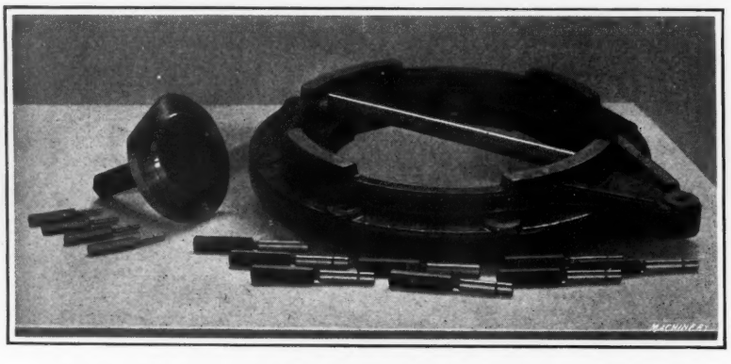


Fig. 22. Hole Gages and Plugs used in testing the Locations of Holes in an Automobile Transmission Case

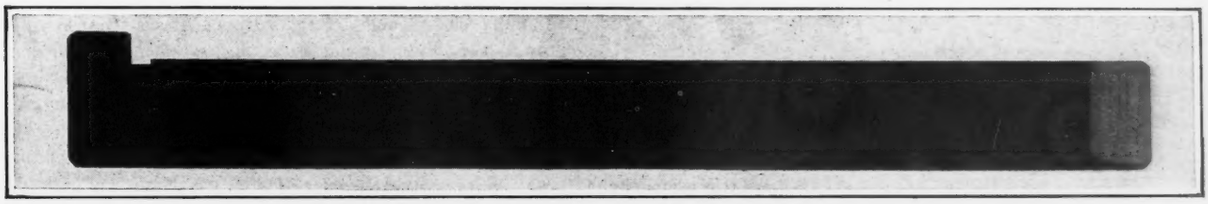


Fig. 23. Gage used for measuring Lengths, the Limits of the Work being indicated by Scribed Lines at the Right-hand End

Discussion of the Factors Involved in Gaging Threads

At the present time, a wide difference of opinion exists as to the proper method of testing threads. Owing to the fact that a thread is a complicated composite surface, and that any composite surface is difficult to measure readily, and also because threads are employed in so many places for a wide variety of purposes, this condition is one to be expected. There are three main elements in a threaded surface: The form of the thread, the lead or pitch of the thread, and its diameter. The form of the thread itself is composed of several surfaces. The form of a sharp V-thread is composed of two angular flanks, but this form is theoretical only. A certain amount of rounding or flattening is inevitable at the crest and root. The form of most other standard threads is composed of four surfaces—the crest, the root, and the two flanks. Thus a thread is a composite surface, the accuracy of which depends upon the interrelation of the following: The diameters and form of the crest and root, the form of the two flanks, and the lead.

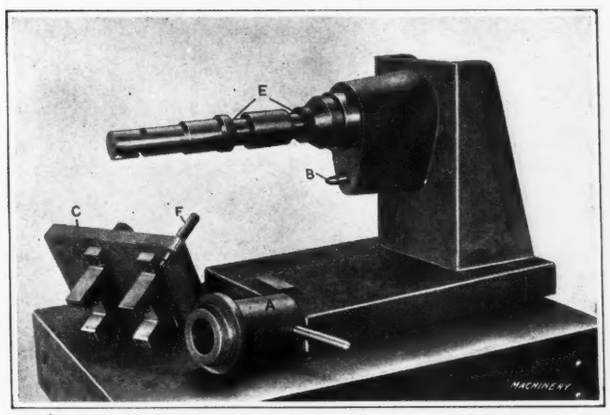


Fig. 24. Gage used in testing Holes in a Transmission Case, the Work being mounted on the Arbor for the Purpose

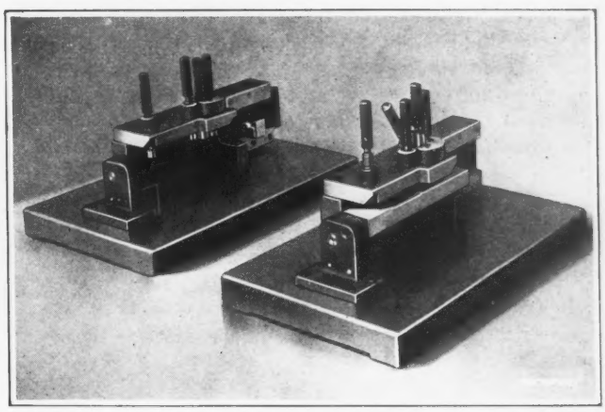


Fig. 25. Another Type of Hole Gage which is a Duplicate of the Drill Jig used in machining the Holes in the Work

There is a broad general principle in regard to limit gages which should always be kept in mind. Where compound tolerances are not involved, a "Go" gage with fixed measuring surfaces may check as many dimensions at one time as desired, and effective inspection will be secured. On the other hand, an effective "Not Go" gage can check only one dimension. By effective inspection is meant assurance that specified requirements in regard to size are not exceeded. The above principle must be applied with common sense, as there are a great many requirements that drawings fail to express clearly. This is especially true in the case of surfaces that are threaded.

The gaging of an externally threaded component will now be considered. A diagram of such a surface, illustrating the terms that will be used in the discussion, is shown in Fig. 26. The outside, or largest diameter, will be called the "major diameter." The smallest diameter will be called the "minor diameter." The top of the thread will be called the "crest," and the bottom, the "root." The sides of the thread will be called the "flanks." The dimension taken square with the axis of the thread from flank to flank at any point, will be called the "effective diameter." The "included angle" is the angle between the flanks of two threads, and the "lead" is the distance from a certain point on one thread to a similar point on the next thread.

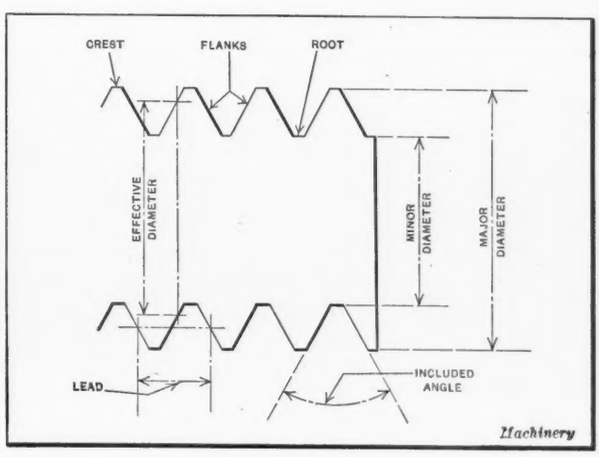


Fig. 26. Diagram illustrating the Meaning of the Terms used in the Discussion on Thread Gages

Method of Expressing Tolerances on Threaded Parts

The correct method of gaging this thread consistently depends on the manner in which the tolerances are expressed. In any event, the major and minor diameters should be treated as independent elementary surfaces. They may be gaged, when necessary, either independently or in conjunction with the other elements on the "Go" gage. The tolerances on the other elements may be expressed in one of two ways—either as a total cumulative error expressed in terms of the effective diameter, which will eliminate compound tolerances, or as individual tolerances on each element, which will introduce compound tolerances with all their resulting annoyances and inconsistencies.

If the tolerances are expressed in the second manner, the only consistent method of gaging would be to provide suitable gages for each element and to test each of them independently. Any gage to test all of the elements at one time would need to be a functional gage and its design would involve a careful study of each set of companion threads to establish the proper dimensions. If the tolerances are expressed in the first manner, the gaging problem is simpler. The "Go" gage may be a ring thread gage checking the "Go" dimensions of all elements. As a matter of economy, in making the gages, it is necessary to provide clearance at that part of the ring gage which

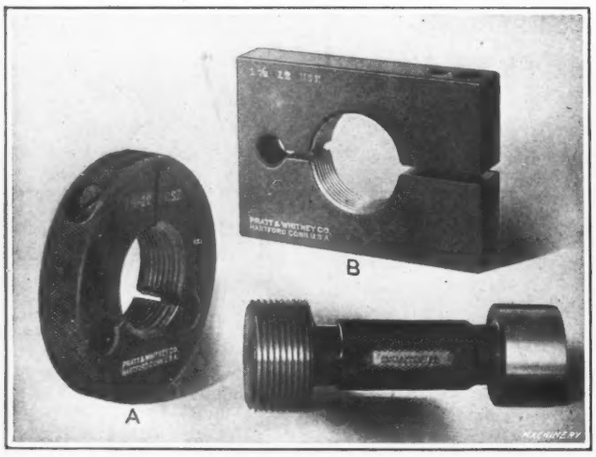


Fig. 27. Standard Ring Thread Gages and a Standard Plug Thread Gage

would check the major diameter, so as to facilitate lapping or grinding. This dimension on the part may readily be checked, when desired, by a simple snap or ring gage.

A decided difference of opinion exists as to the proper length of engagement for thread gages. From an academic viewpoint, the gage should be as long as the effective length of the thread on the component. The effect of the use of longer or shorter gages is to hold the error in the lead of the thread to a lesser or greater amount. Many conditions exist where a relatively large error in lead is not important. In such cases, a shorter gage will make the manufacturing conditions much easier, and at the same time pass only satisfactory parts to meet such conditions. For example, if the length of a gage is reduced to one-half the effective length of the thread on the component, it will permit an error in lead of double the amount which would be allowed by a gage which is as long as the full effective length of the thread on the component.

Theoretically, individual "Not Go" gages should be provided for the major diameter, minor diameter, and effective diameter. Practically, the most severe requirements will usually be met by providing a "Not Go" gage for the effective diameter only. This would be a ring thread gage, made to clear both the major and minor diameters of the component. Its length must be such that it will not engage over one or two turns on the component. As a matter of fact, the strength of the engagement of a screw and nut depends primarily on the amount of the engagement area between the threads.

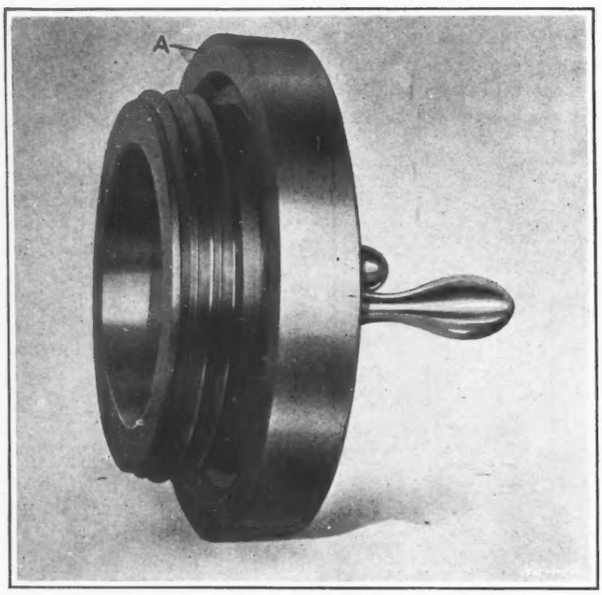


Fig. 28. Qualifying Gage for inspecting the Breech Mechanism of a Large Gun

In many cases suitable inspection will be secured by the use of a "Go" ring thread gage which has clearance at the major diameter of the component, and a "Not Go" ring or snap gage for the major diameters of the component. At *A* in Fig. 27 is shown a standard ring thread gage. The gaging of internally threaded components involves the same problem as the gaging of those threaded externally. A standard plug thread gage for this purpose is shown at *C*. In this case the "Go" gages are made to clear the minor diameter of the component, while the "Not Go" gages are made to clear both the major and minor diameters.

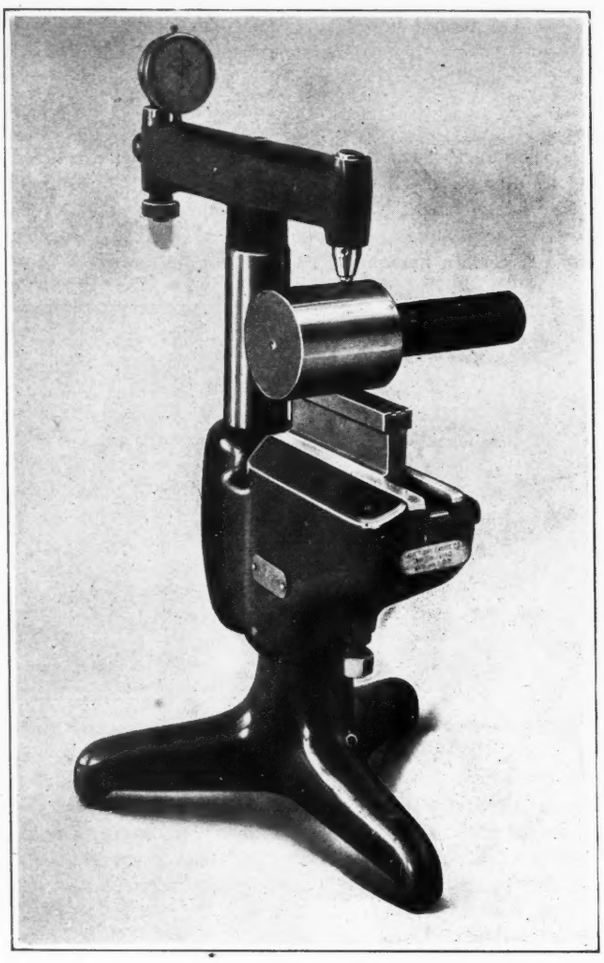


Fig. 29. Amplifying Gage which permits the Rapid Inspection of a Large Variety of Surfaces

Types of Thread Gages

Standard plug and ring pipe thread gages are tapered, and on this account one gage acts both as a "Go" and as a "Not Go" gage. A notch on the gage must be flush with the end of the part within a specified number of turns. These gages are made to clear both the major and minor diameters. In Fig. 28 is shown a "qualifying" gage for the breech mechanism of a large gun. This is a case where the thread must start in a certain specified position. A line is graved on the flange of this gage which must coincide within specified limits, when the gage is screwed home, with another line on the work. The gage measures the relationship between flanks on the work and surface *A* on the gage. This gage is cleared at all points except at surface *A* and on the thread flanks, the angle of the threads being sufficient to center the gage when it is screwed home.

Wing and Indicator Gages

Wing gages are used in some instances where snap gages cannot be conveniently employed. These gages are of the limit type and have two projections or wings. The principle

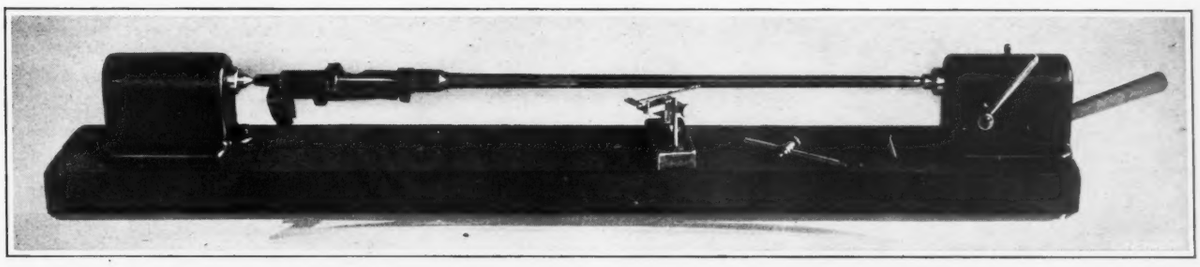


Fig. 30. Indicator set on Bench Centers for testing the Concentricity of a Rifle Barrel

is that one wing must pass the surface of the work to be gaged, while the other must not. This construction permits work to be rapidly and accurately gaged.

Many effective gages can be made simply by providing suitable stands or holding blocks for dial indicators. In one of the prominent watch factories, a large percentage of the gaging equipment is constructed in this manner. These indicators can be set up not only to measure lengths, diameters, etc., but also profiles and locations. Several standard indicating gages are now on the market which require very little in the way of holding blocks, etc., to adapt them to measure a great variety of surfaces. In Fig. 29 is shown an amplifying gage, which is very rapid in operation. In the illustration Fig. 30 is shown an indicator used in connection with bench centers for the purpose of testing the concentricity of a rifle barrel that is assembled with a receiver.

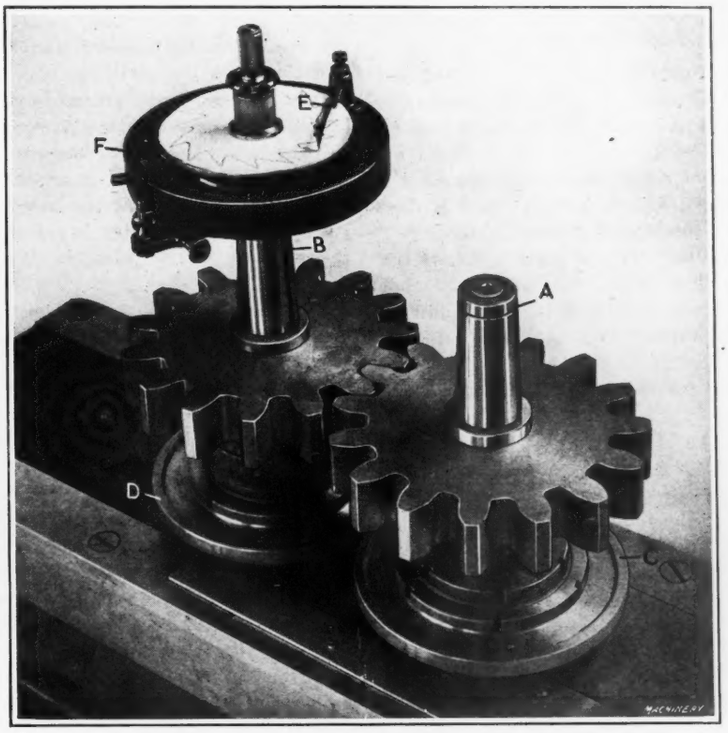


Fig. 31. Machine for testing the Uniformity of Motion between Two Gears, which indicates and records the Amount of Error

Functional Gages

A functional gage is one that tests the functional operation of a component without strict adherence to its exact physical dimensions. Thus, when a repair part is made for a mechanism and fitted to the machine, the machine itself becomes a functional gage for that part. In manufacturing, there are often parts or surfaces on some components which cannot be checked satisfactorily by a series of individual measurements. As a final test for these parts, functional gages are of great value. In some cases, it is possible to eliminate several individual gages, at least for inspection purposes, by the use of suitable functional gages. These duplicate as far as possible the functional conditions required by the mechanism. In fact, in many cases they are almost duplicates of the mechanism itself.

For large work and relatively small rates of production where ordinary gages would be heavy and cumbersome and the number required for effective inspection would be large, the functional gage offers a satisfactory means of gaging. Sometimes, of course, modifications of the design of the mechanism must be made in the functional gages to permit them to be assembled and disassembled readily. In general, they duplicate as far as possible the functional conditions required by the mechanism.

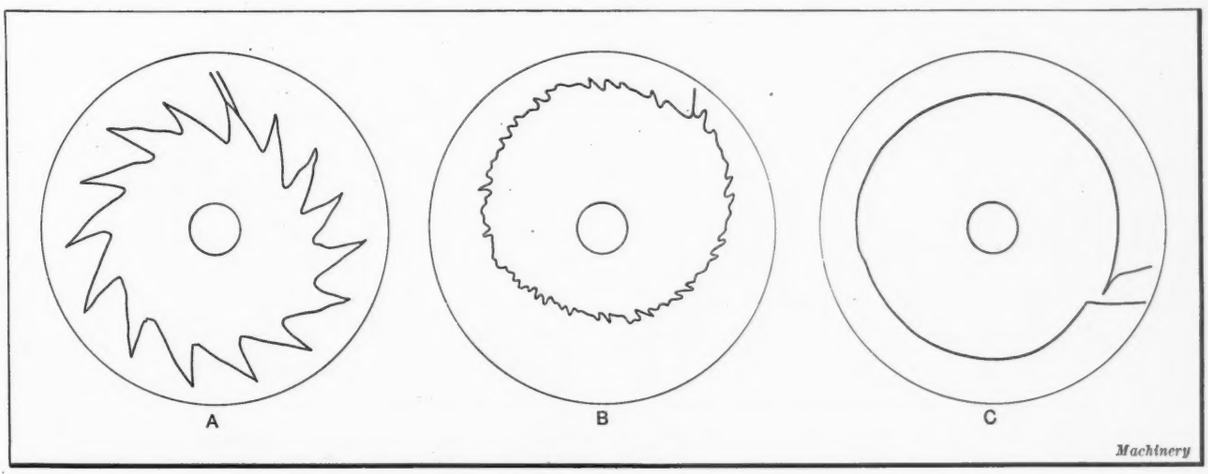


Fig. 32. (A) Chart obtained on Machine illustrated in Fig. 31 from Two Gears cut with Form Milling Cutters. (B) Chart obtained from Two Gears cut on a Gear Generating Machine with a Straight-sided Rack Cutter. (C) Chart secured from Two Gears hardened and then ground in a Grinding Machine of the Molding-generating Type



Fig. 33. Size Blocks being used to check the Distance between the Gaging Surfaces of a Snap Gage

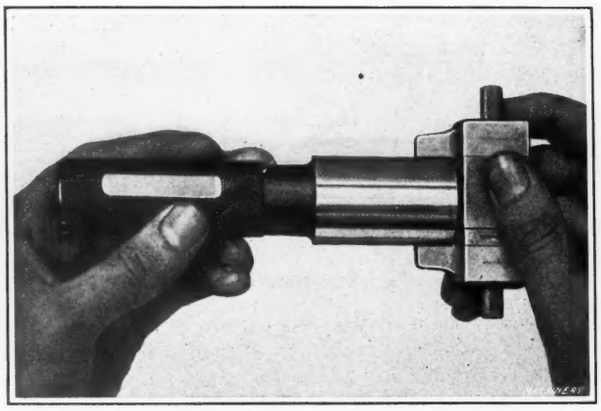


Fig. 34. Application of Size Blocks and End Measuring Attachments for checking the Diameter of a Plug Gage

Functional Gaging of Gears

The satisfactory gaging of gear teeth is a complicated and difficult problem, if each element is tested independently, because of the many factors involved. If the testing is reduced to a functional inspection, however, the problem becomes simpler. The prime object of gears is to transmit a uniform motion, and if this result is accomplished it does not matter what the exact contour or dimension of any of the operating surfaces may be. On the other hand, if the gears do not accomplish this result, the only good that knowledge of the various discrepancies does, is to indicate the possible causes for the error. This is useful information in the making of the gears, but has little value to the inspector who must decide whether or not the gears are acceptable.

There are several important factors governing the functioning of the gears: First, the tooth profile; second, the spacing of the teeth; third, the concentricity of the teeth; fourth, the radial position of the tooth profile; and fifth, the relative thickness of the teeth and spaces or the amount of backlash. Errors in any one of the first four factors will cause an error in the uniform transmission of motion. If one of these factors is to be checked to test for this condition, all four should be checked. The simplest method of testing the backlash is to set the gears in mesh at their proper center distances and actually measure the backlash. Often this can be accurately measured with feeler gages. Another method is to place a piece of soft lead wire between two teeth, run these teeth past the center line, and measure the thickness of the deformed wire.

Description of Gear Gaging Machine

The principal operating parts of a machine for testing the uniformity of motion between two gears are shown in Fig. 31. This fixture not only indicates the amount of error, but also records it on a chart when desired. Its principle is as follows: The gears are mounted on arbors *A* and *B*, which are spaced to the proper center distance. Under each gear is a plain disk the periphery of which is ground to the pitch diameter of the gear. On arbor *A* both the gear and disk *C* are mounted on the same sleeve; but on arbor *B*, which carries the indicating device, the gear is mounted on one sleeve while disk *D* is mounted on another. Indicator *E* is mounted on the sleeve which carries disk *D*, while an arm which engages with the indicator is attached to the sleeve carrying the gear. Plate *F* which carries the chart is mounted on the fixed arbor *B*.

It will be seen that as the two gears are revolved, the two disks will also revolve, while any differences in the angular position of the gear on arbor *B* and disk *D* will be recorded by the indicator. If the gears are correct, the disks of proper diameter, and there is no slipping between them, a perfect circle will be developed on the chart. An error in the diameters of the disks or slipping between them will develop a spiral on the chart. This makes it easy to detect the errors due to the testing machine. An error of thirty seconds in the angular position of the two gears results in a departure from a smooth line of about 1/16 inch on the chart. The indicator will read errors of ten seconds.

At *A* in Fig. 32 is a chart obtained from two fifteen-tooth gears cut with form milling cutters. These are the two gears shown in Fig. 31. At *B* is a chart resulting from two fifteen-tooth gears cut on a gear generating machine with a straight-sided rack cutter. A chart from two twenty-seven-tooth gears, hardened and then ground in a grinding machine of the molding-generating type is shown at *C*.

Special Gages for Rapid Inspection

Whenever an extremely large quantity of duplicate parts must be continuously inspected, special gaging devices and machines are often designed. Many ingenious indicating devices are used for this purpose. Often a large number of flush pins are operated at one time, and their position is indicated by colored lights, electrical contact being made ac-

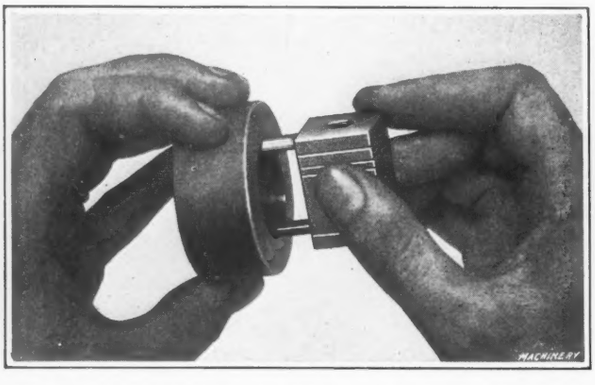


Fig. 35. Checking the Hole of a Ring Gage by Means of Size Blocks and Internal Measuring Ends

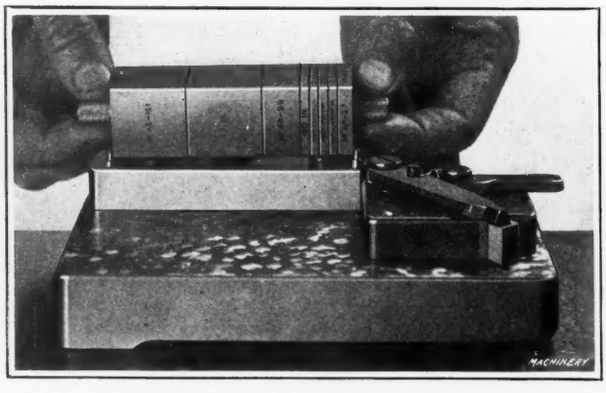


Fig. 36. Employing Size Blocks to test the Distance between Two Pins of a Gage

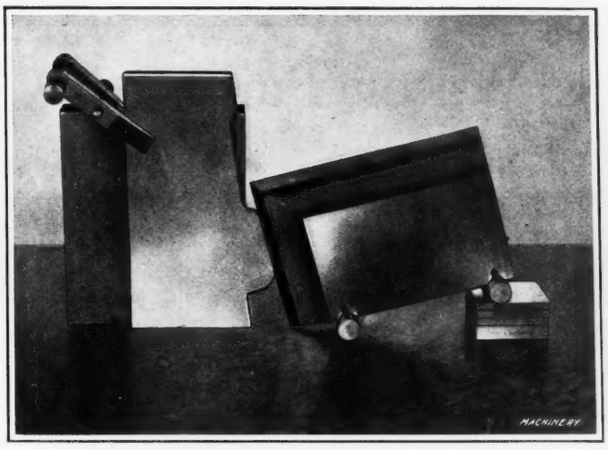


Fig. 37. Use of Size Blocks in Conjunction with a Sine Square for testing the Accuracy of an Angular Surface

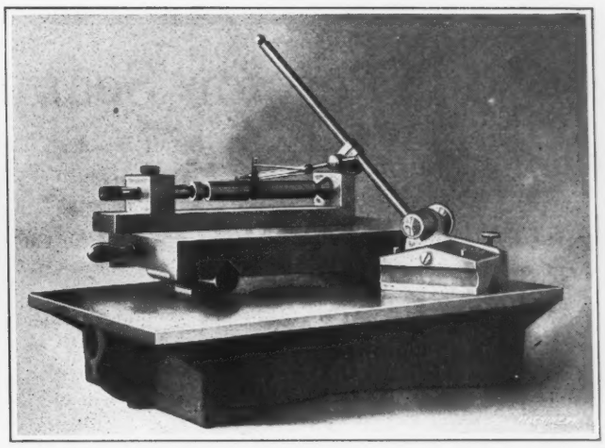


Fig. 38. Illustration showing the Use of a Size Block and Sine Surface Plate in testing a Tapered Part

cording to the location of the end of the flush pin. At other times, several gaging devices are built on a surface plate, while the work is moved readily from position to position. Again, in the case of the inspection of cartridges for small arms, special automatic machines are sometimes built for this purpose—machines which require only the services of an operator to feed the work, while the machine automatically gages and sorts the parts. After all, gaging is one of the important operations required in interchangeable manufacturing, and gaging equipment should be designed to meet the particular needs of each component, due attention being paid to the same factors as govern the design of the other manufacturing equipment.

Master Gages and Reference Gages

It is evident that some means of testing gages for their accuracy must be provided. The extent of this testing equipment depends on the ultimate accuracy required. Gages for forgings or other semi-finished parts can be effectively checked with standard measuring instruments, such as micrometers, scales, height gages, protractors, etc. On the other hand, gages for intricate interchangeable parts must be checked with far greater care and require much better measuring facilities. Devices for checking elementary dimensions, such as length, diameter, thickness, etc., will be considered first. Measuring machines are on the market for establishing such dimensions within very small limits of error.

Accurate size blocks in sets which can be built up to any desired dimension are also on the market. With such equipment, it is seldom necessary to make special master or reference gages for special dimensions. The older practice was to make up special size blocks for every important gage—a practice which was very expensive. A set of size blocks, with a few attachments, will cover a wide field of checking and eliminate the need of the great majority of special reference gages. For example, in Fig. 33, several blocks are being used to check a snap gage. In Fig. 34, with the use of end measuring attachments, several others are used to check a plug gage. Again, in Fig. 35, size blocks are being used with internal measuring ends to check a ring gage. Fig. 36 illustrates their use in testing the location of two pins in a gage. A more elaborate set-up is shown in Fig. 37. Here a sine square and size blocks are employed for testing the accuracy of an angular surface. Fig. 38 shows their use with a sine surface plate to test a taper.

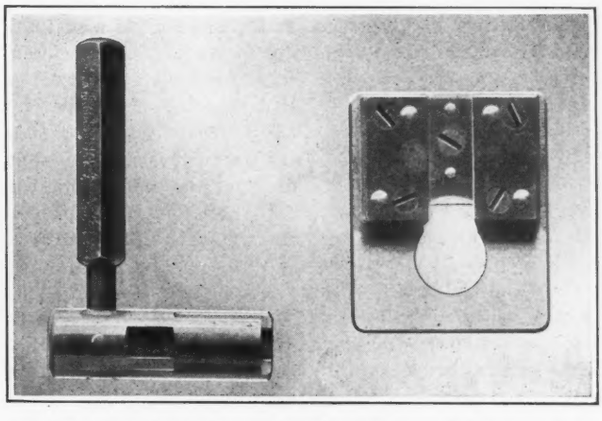


Fig. 39. Gage for testing a Composite Surface, and Reference Gage employed in its checking

In each of the above cases, every surface has been treated as an elementary surface for the purpose of testing. For the rapid testing of composite surfaces, however, special master or reference gages are required. Sometimes these masters are tried directly on the gage. Such is the case with the master shown to the right in Fig. 39. In other cases, the master is a duplicate of the gage itself, and the gage is tested by comparative measurements from the master. This is common practice with plug thread gages. A measurement is taken with thread micrometers or over wires on the master gage, and a similar measurement is taken on the gage itself. The comparison between the two measurements determines the conditions of the gage.

* * *

BUSINESS COURSE FOR WORKMEN

A workman's forum is being organized this summer in a number of plants under the auspices of the Business Training Corporation, 185 Madison Ave., New York City, for the purpose of giving employes a sounder knowledge of the economics of business and an appreciation of the problems of management. The need for such education is apparent, as many industrial misunderstandings can be traced to wrong thinking and misinformation along these lines.

The forum will include plant managers, foremen, and selected workmen, and will cover five consecutive weeks. At each meeting a lecture will be given by a speaker supplied by the Business Training Corporation, and text pamphlets which have been read by the forum members during the week will be discussed. The subjects of the five lectures and texts are: "The Three Partners in Industry"; "Cheaper Goods with Higher Pay"; "Production Made Easy"; "Bigger Men in Better Jobs"; and "Making a Better Living." Such a course should give the worker an idea of the part that management plays in helping him earn his living; point out opportunities for bettering himself through serving the company; remove tendencies toward distrust; build up plant morale; and encourage teamwork. The forums are under the direction of John Calder, manager of the industrial relations department of Swift & Co., and Meyer Bloomfield who organized the industrial activities in the shipbuilding field during the war.

Dies for Seamless Water Pails

By J. BINGHAM, President, The B. J. Stamping Co., Toledo, Ohio

THE seven punch press operations required in the manufacture of a seamless water pail and the dies used in the performance of each operation are described in this article. The first of these operations is a blanking operation; the next four are drawing operations in which the pail or shell is drawn to the desired shape; the sixth operation consists of trimming a flange formed on the open end of the shell; and the final operation consists of bending this flange around a wire to form the rim of the pail. In order to permit the construction and operation of the drawing dies and curling or wiring die to be thoroughly understood, illustrations of these dies are presented. A dimensioned drawing of the work as it appears after each drawing operation, is shown beneath the die. The blanking and trimming dies employed in the production of this part are of standard construction and for this reason are not illustrated. The metal from which the shell is produced is sheet steel, 0.028 inch thick, of a deep drawing quality, the blank being cut to a diameter of 18¼ inches in the blanking operation.

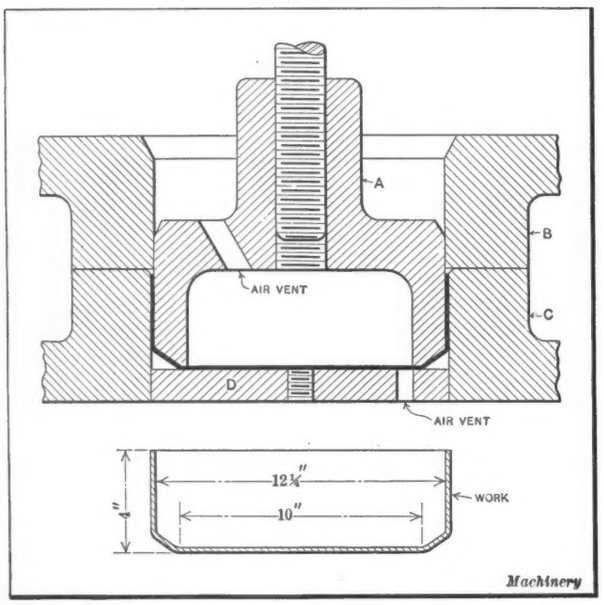


Fig. 1. Double-action Drawing Die employed in First Shaping Operation on Shell

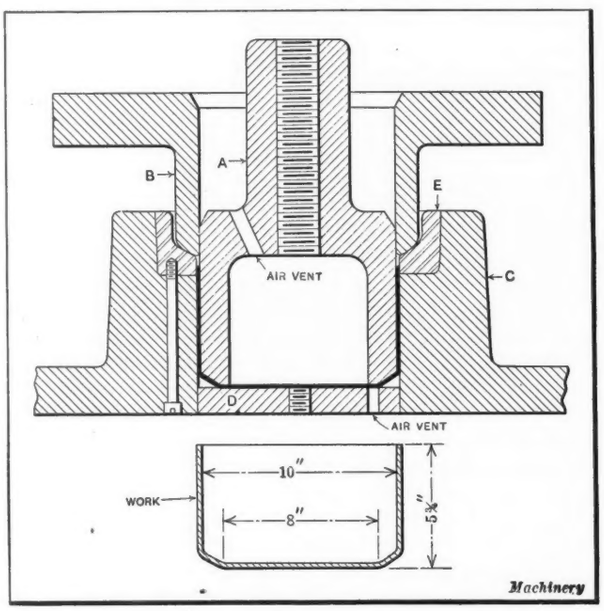


Fig. 2. Drawing Die used to reduce the Shell Diameter and increase the Length

First Drawing Operation on the Shell

The die used in the first drawing operation on the shell is illustrated in Fig. 1. This is a double-action die which is used in connection with a double-action press and consists essentially of punch *A*, blank-holder *B*, die-block *C*, and knock-out pad *D*, all of these parts being made of cast iron. Prior to an operation with this die, a blank is placed on the upper surface of die-block *C*. Then on the downward movement of the press ram, blank-holder *B* descends slightly in advance of punch *A* until it exerts a certain pressure on the blank, at which time its descent is stopped by means of the operating mechanism of the press. The blank is drawn to the desired cup shape by punch *A* as it continues to descend after the blank-holder has been stopped, drawing the blank from between the blank-holder and die-block into the opening in the die-block. On the return stroke of the ram, the shell is forced from the punch by coming in contact with the bottom surface of the blank-holder which overhangs the die opening. Knock-out pad *D* is provided for ejecting the shell from die-block *C*.

It will be noted that punch *A* is cored out for the purpose of lightening it. An air vent is provided in both the punch and knock-out pad to permit the ready escape of air when the punch and shell descend into the die. This is an important requisite on dies of this type. Mention has already been made of the fact that the various parts are made of cast iron, it having been the experience of the writer that this material is a very good drawing medium for producing light metal parts of comparatively large dimensions.

Successive Reducing Operations Performed with Double-action Dies

The double-action die used in the second drawing operation in which the diameter of the shell is reduced, consequently increasing its length, is shown in Fig. 2. Punch-holder *A*, blank-holder *B*, die-block *C* and knock-out pad *D* are all made of cast iron. The die-block, however, is provided with an inserted ring *E* made of chilled cast iron. In the operation of this die the shell is seated on the tapered surface of the die ring *E*, which is ground to suit the bottom of the shell as formed in the preceding operation. On the downward movement of the press, blank-holder *B* descends into the shell and exerts a pressure on the inside of the taper surface on the bottom of the shell, at which point its downward movement is ended. The shell is then drawn to the dimensions shown by punch *A* as it continues to descend, drawing the shell from between the blank-holder and the die ring. The means provided for the escape of air and for the removal of the shell from the punch and die are similar to those on the die previously described.

Fig. 3 shows the die employed for the performance of the next operation, which consists of making another reduction in the shell diameter and at the same time increasing its length. The open end of the shell is bell-mouthed in this operation to facilitate the forming of a flange in the succeeding operation. This die is also of the double-action type, and as its construction and operation are very similar to

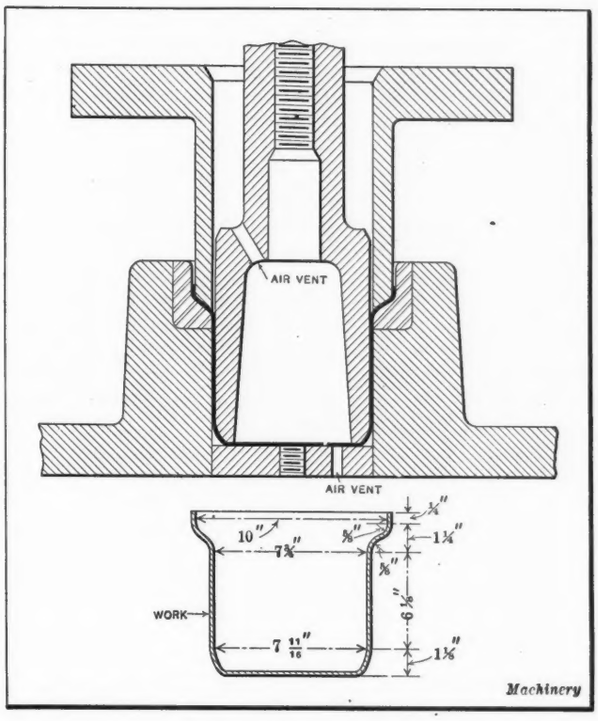


Fig. 3. Operation in which the Shell Diameter is further reduced while the Open End is Bell-mouthed

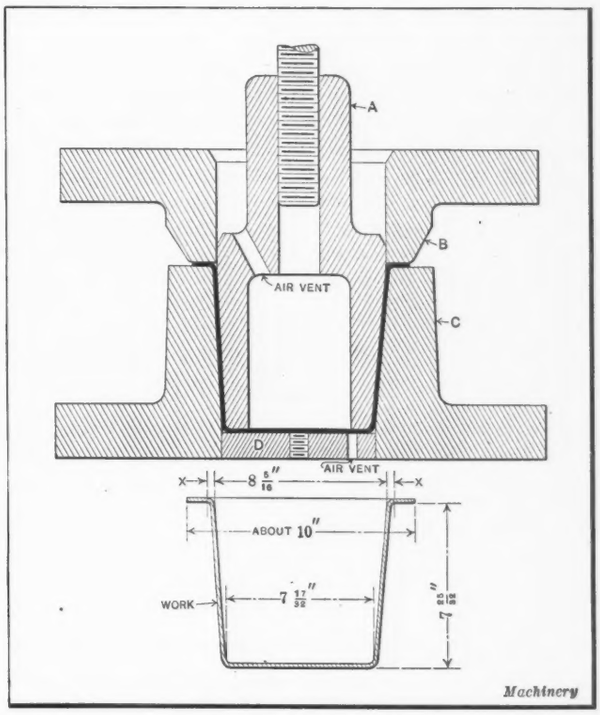


Fig. 4. Final Drawing Operation in which the Body of the Shell is tapered and a Flange is formed on the Open End

that of the die shown in Fig. 2, a more detailed description is unnecessary.

The double-action die illustrated in Fig. 4 is used for the fourth drawing operation in which the body of the shell is drawn to a taper while the bell-mouthed opening is flattened to form a flange. As in the dies previously described, punch *A*, blank-holder *B*, die-block *C* and knock-out pad *D* are made of cast iron. In preparing for this operation, the outside surface of the bell-mouthed portion of the shell formed in the preceding operation is seated on the top surface of die-block *C*, the body of the shell projecting into the die opening. It will be noted that the end of blank-holder *B* is beveled to permit its ready entry into the shell opening when the blank-holder descends on the downward stroke of the press. The shell is pressed firmly on die-block *C* by blank-holder *B*, while the punch *A* descends and draws the shell to shape, the flange being formed by means of the flat bottom surface of the blank-holder. The removal of the work from the punch and die, after the completion of the operation, is effected in the same manner as on the dies previously described. The sixth operation consists of trimming the flange of the shell close up to the rounded corner at the open end as indicated by lines *X* in the detail drawing of the work shown in Fig. 4. The construction of the trimming die used in this operation is not illustrated.

Die Employed in Wiring Operation on Pail

The final press operation on the pail consists of forming a depression in the bottom surface and curling the edge of the open end over a wire placed around the outside of the pail. The die used for accomplishing these results is shown in Fig. 5. It will be noted that the punch is built up of a number of parts consisting mainly of punch-holder *A*, curling ring *B*, nose-piece *C*, disk *D*, rubber buffer *E*, and fillister-head screw *F*. When the punch is lifted from the die there is a clearance between curling ring *B* and the upper surface of nose-piece *C* equal to the clearance shown between the head of screw *F* and disk *D*. Die-block *G* is provided with die ring *H* which is in a raised position prior to the descent of the punch, the purpose being to hold up the wire, around which the edge of the pail is to be curled, when ring *B* is engaged in this curling process. Die ring *H* is raised to this position by means of several coil springs placed between the die-block and the die ring, the height of the position being determined by the head of screw *I* coming in contact with the die-block.

Prior to the performance of an operation in this die, the wire around which the edge of the bucket is to be curled, is laid upon the die ring *H*, and the shell is inserted through the wire into the die. On the downward movement of the press ram, nose-piece *C* enters the die, and the pressure exerted by the rubber buffer *E* between the nose-piece and disk *D*, causes a depression in the bottom of the bucket. The pressure is exerted on all surfaces of the shell during the curling portion of the operation. There is sufficient clearance allowed between nose-piece *C* and wire ring *B* to permit the nose-piece to hold the shell firmly before the curling process commences. The edge of the shell is curled around the wire by ring *B* as the punch-holder descends, and at the same time die ring *H* is forced down on die-block *G*.

On the return stroke of the punch, the rubber buffer holds the nose-piece and the work in the die until the head of screw *F* comes in contact with disk *D*, after which the

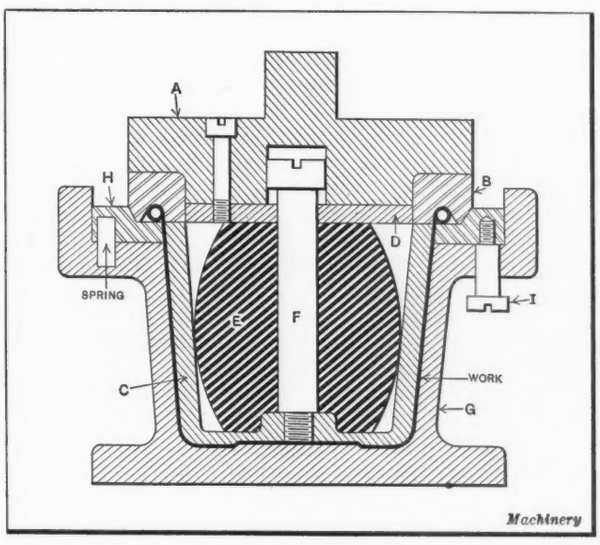


Fig. 5. Die used to curl the Edge of the Shell at the Open End around a Wire

nose-piece and the buffer are also withdrawn as the punch continues to ascend. The shell is raised from the die by die ring *H* as this ring returns to its original position due to the pressure exerted by the coil springs previously referred to. It is always essential to provide a nose-piece and a rubber buffer or other similar means of exerting pressure on the various surfaces of the work during a curling operation, in order to insure that the form of the body of the shell will remain unchanged by this operation. The dies described in the foregoing were developed by the writer while superintendent of the Toledo Machine & Tool Co.

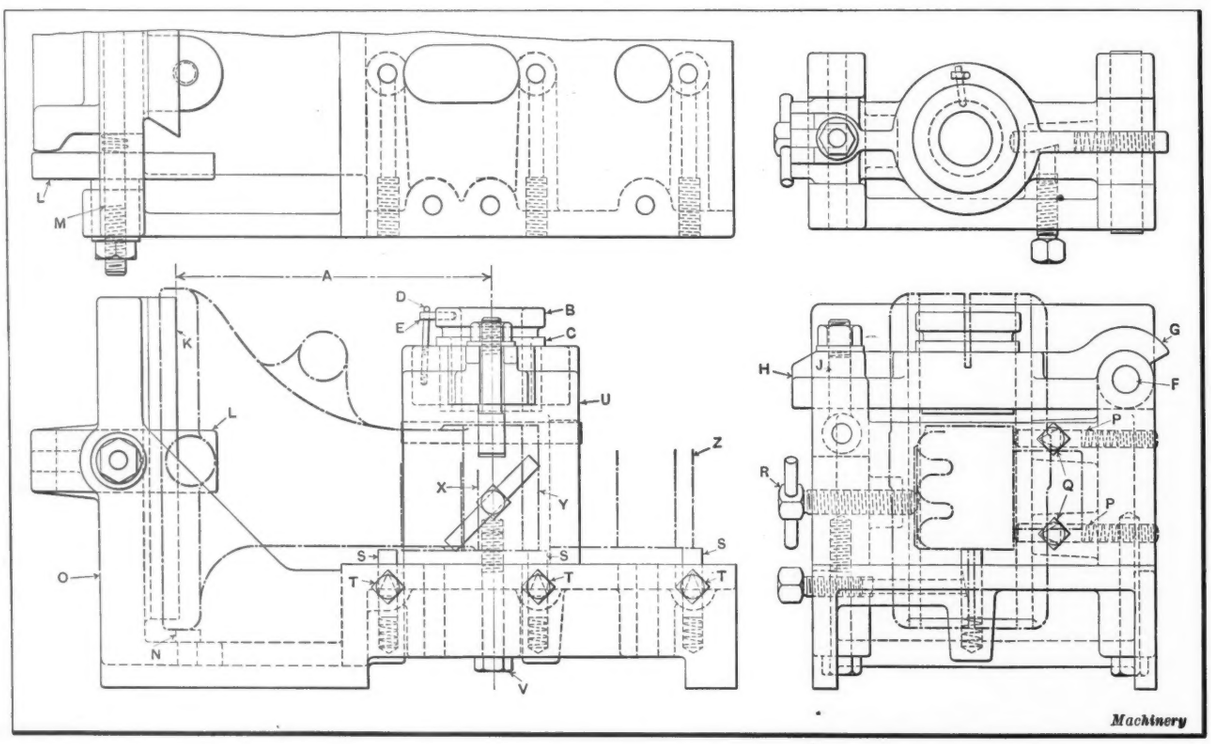
* * *

DRILL JIG FOR BRACKETS OF DIFFERENT LENGTHS

A jig designed for use in drilling and reaming the hole through the boss of a bracket that is made in three different lengths is shown in the illustration. The work is illustrated by heavy dot-and-dash lines, the dimension that varies on the different brackets being indicated at *A*. The location of the bosses of the various lengths of brackets which can be accommodated in the jig is indicated by the reference letters *X*, *Y*, and *Z*, the jig as illustrated being set for machining the hole in a bracket having the boss at location *Y*. The principal parts of the jig consist of the base *O*, the movable block *U*, and the swinging leaf *H* which contains the slip bushing *B* and which hinges on pin *F*. The movable block can be placed in three different positions to suit the length of the bracket being machined, and is secured to the base by two bolts *V*, holes being drilled in the base at the different positions to suit these bolts. The movable block is located in the exact position on the base by means of two dowel-pins which are not illustrated.

After the movable block has been secured in the proper position for machining a bracket, the swinging leaf *H* is raised until lug *G* comes in contact with the movable block. Then the work, which has a dovetail groove at the large end, is placed on tongue *K* on base *O*, the bottom end resting upon pin *N*. The work is then clamped to the base by means of two clamps *L*, one of which can be seen in the partial plan view of the base. These clamps are tightened on the work simultaneously by turning the nut on bolt *M* which passes through both clamps. The swinging leaf is then lowered and locked in place by the eye-bolt *J*. The boss end of the bracket rests upon one of the pins *S*, each of which is provided with a spring that raises the pin until it comes in contact with the bottom surface of the boss. The pin is then clamped in this position by means of screw *T* which has a taper surface at the end corresponding to the taper surface on the pin. This arrangement prevents the pin from altering its position during the operation and offers a firm support to this end of the bracket. Originally, ordinary pins were used instead of spring pins, but the vertical height between the rough surface of the bracket resting upon pin *N* and the finished surface of the boss which rests on pin *S*, was often so great that the boss did not rest upon the pin. The result was that the casting sprung during the operation on account of the leverage caused by the distance of the boss from the dovetail groove.

Spring pins *P* and the binding screw *R* are used to prevent sidewise movement of the bracket during the operation. After the bracket is placed in the jig and pins *P* are in contact with the side of the boss, the screws *Q* are tightened, thus clamping the pins in place. The binding screw *R* is then also tightened so that the boss is held firmly between it and pins *P*. The construction of pins *P* and screws *Q* is similar to that of pins *S* and screws *T*, respectively.



Drill Jig having Movable Member to adapt it for machining Brackets of Similar Design but of Different Lengths

It will be noted that the slip bushing *B* is held in a permanent bushing *C* and is prevented from turning by means of the locking pins *D* and *E*. Lug *G* is provided on the swinging leaf to prevent it from being thrown back so far that it would be liable to become damaged. Care must be exercised in changing the movable block *U* from one position to another, to see that no chips or other foreign matter is on either of the contact surfaces of the block and base *O*. Such an occurrence might destroy the alignment of the drill bushing with the work, and it is well to test the first piece machined after the position of block *U* has been changed, to see whether it is within the requirements. In using this jig, a comparatively large number of brackets of one length were usually machined together so that the movable slide did not need to be changed frequently. Jigs designed on the principle outlined will be found of considerable value, not only because of their convenience, but also because of their time-saving features.

H. M.

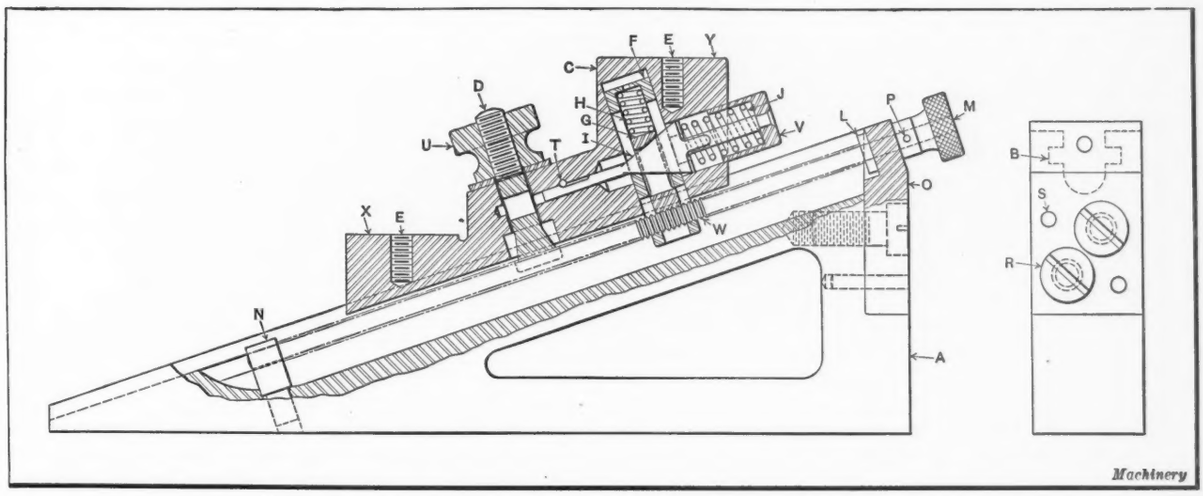


Fig. 1. Planer Tool-setting Gage with a Vernier for obtaining Direct Readings and Means of securing Quick or Accurate Adjustments

Precision Type of Planer Tool-setting Gage

A Tool-setting Gage Provided with a Vernier for Obtaining Direct Readings and with Means for Securing Quick and Accurate Adjustments

By GUSTAVE YOUNGQUIST

A GAGE that is frequently used for setting a planer tool to the proper height for taking a cut on a piece of work, consists essentially of a base having an inclined surface on which is mounted a sliding member. This sliding member has two upper surfaces that are always parallel with the bottom of the base. By this arrangement the sliding member can be set so that a measurement taken from the bottom of the base to one of the upper surfaces of the sliding member will equal the height to which a planer tool is to be set. The planer tool is then set for taking the desired depth of cut by placing the gage on the planer table or on some convenient surface of the work, and then lowering the planer head until the tool rests upon the proper tool-setting surface of the gage. Planer gages of this type are no doubt familiar to most shop men, as they are manufactured by a leading small tool concern. In the illustration Fig. 1 is shown a tool-setting gage, the design of which is based on the same principle as the commercial product, but this gage is so constructed as to provide means for obtaining either a quick or an accurate adjustment, and it is also provided with a vernier that permits the reading of the setting to be taken direct in thousandths of an inch. The provision of the vernier eliminates the necessity of using a micrometer or other measuring means that must be employed on the commercial type of gage to ascertain to what height the sliding member of the gage should be set.

Construction of the Gage and Methods of Obtaining Accurate or Quick Adjustments

The angle between the inclined and the bottom surfaces of base *A* is 18 degrees 30 minutes. The smaller this angle, the finer the adjustments that can be obtained with the gage, but the range of heights is at the same time decreased. It has been found that an angle of the magnitude given is well suited for most shops in which such a gage is used. Base *A* is provided with a T-slot *B* in which a tongue on the bottom of slide *C* and the head of the clamping screw *D* slide. Slide *C* is machined in the customary manner with two tool-setting surfaces *X* and *Y*, which are parallel with each other and with the bottom surface of base *A*. The difference in height between these two gaging surfaces is one inch. The tapped holes *E* are provided so that attachments can be mounted on these surfaces to permit planer tools to be set to heights ordinarily beyond the capacity of the gage. Both the base and slide are made of low-carbon steel and are hardened and ground on their wearing surfaces. In addition to this, the sides of the tongue on slide *C* and the corresponding wearing surfaces of the T-slot in base *A* are lapped. Fig. 2 shows details of slide *C* and some of the other gage parts, the construction of which might not be readily understood by referring only to Fig. 1. The reference letters of these details are identical with the letters used in referring to the same parts in the illustration Fig. 1.

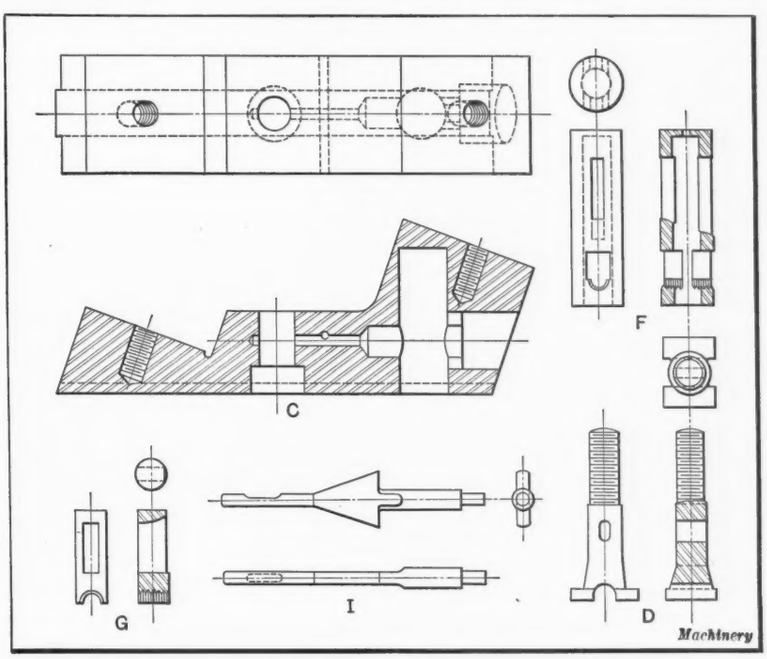


Fig. 2. Details of Tool-setting Gage illustrated in Fig. 1

The fine adjustment of the gage is obtained by means of a fine-pitch screw *W* which has a bearing at one end in bracket *O* and at the other end in stud *N*. Bracket *O* is also made of low-carbon steel and is hardened and ground. It is secured to base *A* by two fillister-head machine screws *R* and two dowel-pins *S*. The upper portion of the bracket is machined so as to form bearing surfaces for the knurled head *M*, which takes the end thrust of screw *W* in one direction, and for washer *L* which takes the thrust in the opposite direction. Head *M* is secured to screw *W* by means of pin *P*. Stud *N* is driven into a reamed hole which extends to the bottom surface of the base so as to permit the stud to be readily removed if this should prove necessary.

Nut parts *F* and *G* are used in conjunction with screw *W* when obtaining accurate adjustment of the gage. Reference should be made to Fig. 2 in order to understand the construction of these parts. It will be noted that part *F* is cylindrical and contains a hole in which plunger *G* operates. A hole in the lower part of *F* is threaded to fit the bottom half of screw *W*, while part *G* is threaded to fit the upper half. These two parts are tightened on the screw by means of the expansion coil spring *H*, which exerts pressure on both members. When these nut parts are in engagement with the screw, the slide can be accurately raised or lowered by turning head *M* in the proper direction, provided clamping screw *D* is previously loosened by turning knurled nut *U*. Part *F* is properly machined to clear screw *W* when ob taining quick adjustment by the method to be described later. Parts *F* and *G* are made of tool steel and are hardened and ground, the threaded portion of these parts being lapped to insure a smooth working action with the screw.

When desiring to obtain a quick adjustment of the slide, clamping screw *D* is first loosened. Nut parts *F* and *G* are then released from contact with screw *W* by pressing on knob *V* by hand, which compresses the expansion coil spring *J* and forces the wedge-shaped push-pin *I* forward. The upper taper surface of the push-pin engages with a slot similarly machined in part *G*, while the lower taper surface of the push-pin engages with a similar inclined surface on part *F*. Thus, as push-pin *I* is forced forward, the movement causes part *G* to be lifted and part *F* to be lowered out of contact with the adjusting screw. The slide may then be moved by hand to any desired position. As soon as the pressure is relieved on knob *V*, spring *J* forces pin *I* back to the position illustrated, while spring *H* again forces parts *F* and *G* in contact with screw *W* for obtaining accurate adjustments. Push-pin *I* is also made of tool steel, and is hardened and ground.

By referring to the detail of slide *C*, it will be noted that the hole in which knob *V* operates is counterbored, the resulting wall providing a contact surface for spring *J*. A slot is machined through this wall to accommodate push-pin *I*. The push-pin is prevented from being forced out of the slide by pin *T*, which fits into a hole drilled through the slide, and contacts with a flat surface on the upper side of the push-pin. Clamping screw *D* is provided with a slot into which the end of the push-pin extends when it is forced forward in order to permit a quick adjustment of the sliding member to be obtained.

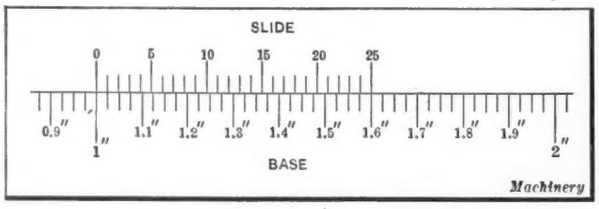


Fig. 3. Vernier Scale provided on Base and Slide to permit Easy Reading of the Setting

Description of the Vernier Scale

The vernier scale provided on this gage to permit direct readings of the tool settings, is graduated on adjacent sides of base *A* and slide *C*. The base is graduated in such a manner that when slide *C* is moved a distance of one graduation along the base, the vertical height between the bottom surface of the base and surfaces *X* and *Y* is increased 0.025 inch. The vernier gives the direct reading of the measurement between surface *X* of the slide and the bottom of the base. In order to obtain the height of surface *Y* at any setting, it is necessary to add one inch—the vertical distance between surfaces *X* and *Y*—to the reading of the vernier. The vernier scale provided on the gage is shown in Fig. 3. As the movement of the slide past one graduated space on the base raises it a distance of 0.025 inch, it is obvious that it is necessary to move the slide a distance of forty spaces in order to raise it one inch vertically.

The scale on the slide has twenty-five graduated spaces, the total distance between the extreme graduations being the same as the length of twenty-four spaces on the base. Thus it is evident that the vertical distance corresponding to each graduation on the slide is equal to $24/25 \times 0.025 = 0.024$ inch. The difference in height represented by the spaces on the base and those on the slide is therefore 0.001 inch, so that the taking of readings in thousandths of an inch is possible. Preparatory to graduating the base and slide, it was necessary to first determine the actual distance between each graduation on these parts. As previously stated, a movement past forty spaces on the base effects a vertical rise of one inch of the slide. The actual distance on the base between the inch graduations was then readily determined by multiplying one inch by the cosecant of 18 degrees 30 minutes, the angle elevation of the base. Thus, $3.1515 \times 1 = 3.1515$ inches, or the distance between the inch graduations. The distance between each 0.025-inch graduation, therefore, equals $3.1515 \div 40 = 0.0788$ inch. As the total length of the scale on the slide is equal to twenty-four spaces on the base, the total length of the slide scale is equal to $24/40 \times 3.1515 = 1.8909$ inches. The length of each space on the slide therefore, equals $1.8909 \div 25 = 0.0756$ inch.

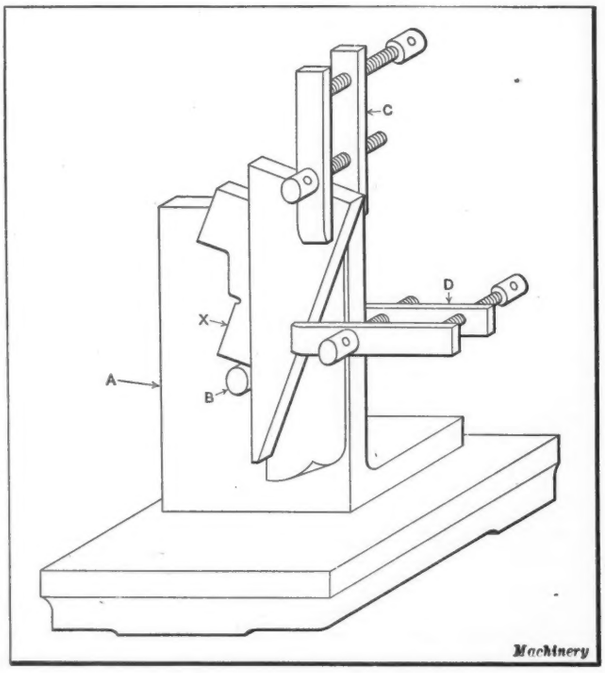


Fig. 4. Method of locating and securing Slide and Base on an Angle-plate for the Graduating Operation

Graduating the Vernier Scales on the Base and Slide

In placing the graduations on the parts, the slide was set on the base in such a position that a micrometer reading gave the distance between the bottom surface of the base and surface *X* of the slide as one inch. The surface to be graduated was then covered with a thin film of beeswax, although any other acid-resisting substance could be used. The gage was

mounted on an angle-plate, a piece of paper being placed under the base as shown in Fig. 4. The angle-plate *A* was provided with a removable plug *B* against which the lower end of the slide was placed, this end having been previously ground. The inclined surface of the base was placed in a vertical position, and the base was secured in this position by means of parallel clamps *C* and *D*. After arranging the gage on the angle-plate in this manner, the next step was to locate and scribe the one-inch graduation on the base and the zero graduation on the slide.

The length of the inclined surface or base of the slide is 2¼ inches, and as the scale is located centrally along this surface, it was necessary to calculate the distance from the lower end of this surface to the zero graduation. This distance is equal to 1.125 — (1.8909 ÷ 2) or 0.180 inch. A line of suitable length was then scribed on both the slide and base perpendicular to their inclined surfaces, the correct location of the line being obtained by means of a set of precision gage-blocks, although a height gage or another planer gage set to the proper height could have been employed to accomplish the same purpose.

After this first line had been located and scribed, the slide and plug *B* were removed from the plate, the base, however, remaining clamped in the same position. The inclined surface of the base and the T-slot in the base were given a coating of beeswax so that these surfaces would not become harmed by the application of the acid used in etching the graduation lines and figures on the part. The scribing of the remaining graduations was then accomplished by the aid of gage-blocks, the number of graduations on the base beneath the one-inch graduation being determined by measuring the distance from this graduation to the bottom end of the inclined surface and dividing this measurement by 0.0788 inch, the actual distance between each graduation. There proved to be sufficient space for fifteen graduations, and after the lowest one was located and scribed, the remaining graduations were scribed in order along the inclined surface. When the lines had all been laid out carefully, the base was removed from the angle-plate and etching acid applied. The figures on the scale were etched later.

After the graduating of the base had been completed, the slide, having also been coated with beeswax, was replaced on the angle-plate in the same position as when the zero graduation was scribed, but with a straight block occupying the position previously occupied by the base. The twenty-five graduations of this scale were then scribed and etched on the slide by using the same methods employed in graduating the base. In shops where the dimensions to which work must be machined are given in millimeters, a vernier scale could also be placed on the opposite sides of the slide and base to permit planer tools to be set according to this system of measuring. It is evident that in such a scale the length of the space between the graduations would differ from that between the spaces in the inch vernier scale.

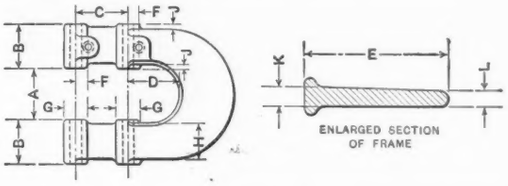
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DIMENSIONS FOR SNAP GAGE FRAMES

By J. B. CONWAY

The accompanying table gives all the dimensions necessary for proportioning a set of snap gages for handling work up to and including 17 inches in length. Although the illustration shows the adjustable measuring point type of gage, equipped with screws for securing the adjustment after it has been obtained, such features are arbitrary and can be disregarded when designing the frame. The material used may be either cast or malleable iron, and both the interior and exterior surfaces surrounding the holes should be finish-ground parallel and perpendicular to the center lines of the adjusting points.

PROPORTIONS FOR SNAP GAGE FRAMES



Frame No.	Range, Inches	Dimensions of Frame, Inches										
		A	B	C	D	E	F	G	H	J	K	L
1	0-¼	½	⅞	5/8	9/16	1 5/16	0.220	½	¾	1/16	5/32	⅛
2	¼-½	¾	15/16	5/8	11/16	1⅜	0.220	½	13/16	1/16	5/32	⅛
3	½-¾	15/16	1	5/8	13/16	1 7/16	0.220	½	⅞	1/16	5/32	⅛
4	¾-1	1 3/16	1 1/16	¾	1	1½	0.220	½	15/16	1/16	5/32	⅛
5	1-1¼	1 7/16	1⅛	¾	1⅛	1 9/16	0.250	5/8	1	1/16	3/16	5/32
6	1¼-1½	1 11/16	1 3/16	¾	1¼	1⅝	0.250	5/8	1 1/16	1/16	3/16	5/32
7	1½-1¾	1 15/16	1¼	¾	1½	1¾	0.250	5/8	1⅛	1/16	3/16	5/32
8	1¾-2	2 3/16	1 5/16	¾	1⅝	1⅞	0.250	5/8	1 3/16	1/16	3/16	5/32
9	2-2½	2 11/16	1⅜	⅞	1⅞	2	0.312	¾	1¼	1/16	¼	3/16
10	2½-3	3 3/16	1 7/16	⅞	2¼	2¼	0.312	¾	1 5/16	1/16	¼	3/16
11	3-3½	3 11/16	1½	⅞	2½	2½	0.312	¾	1⅜	1/16	¼	3/16
12	3½-4	4 3/16	1 9/16	1	2¾	2¾	0.312	¾	1 7/16	1/16	¼	3/16
13	4-4½	4¾	1⅝	1	3¼	3	0.343	⅞	1 7/16	3/32	5/16	¼
14	4½-5	5¼	1 11/16	1⅛	3½	3¼	0.343	⅞	1½	3/32	5/16	¼
15	5-5½	5¾	1¾	1⅛	3¾	3½	0.343	⅞	1 9/16	3/32	5/16	¼
16	5½-6	6¼	1⅞	1¼	4⅛	3¾	0.343	⅞	1 11/16	3/32	5/16	¼
17	6-7	7¼	2	1¼	4⅝	4	0.410	15/16	1 13/16	3/32	⅜	¼
18	7-8	8¼	2⅛	1½	5⅛	4¼	0.410	15/16	1 15/16	3/32	⅜	¼
19	8-9	9¼	2⅛	1½	5¾	4½	0.440	1	1 15/16	3/32	⅜	¼
20	9-10	10¼	2¼	1½	6¼	4½	0.440	1	2 1/16	3/32	⅜	¼
21	10-11	11¼	2¼	1½	6¾	4¾	0.470	1⅛	2 1/16	⅛	⅜	¼
22	11-12	12¼	2½	1¾	7⅜	4¾	0.470	1⅛	2¼	⅛	⅜	¼
23	12-13	13¼	2½	1¾	7⅞	5	0.470	1⅛	2¼	⅛	7/16	5/16
24	13-14	14¼	2¾	1¾	8⅜	5	0.570	1¼	2½	⅛	7/16	5/16
25	14-15	15⅜	2¾	1¾	9	5½	0.570	1¼	2½	⅛	7/16	5/16
26	15-16	16⅜	3	1¾	9½	5½	0.570	1¼	2¾	⅛	7/16	5/16
27	16-17	17⅜	3	1¾	10	5½	0.570	1¼	2¾	⅛	7/16	5/16

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THE METRIC SYSTEM AND THE ENGINEERING PRESS

This number of MACHINERY contains an article dealing with the adoption and use of the metric system in a large American machine-building plant. The article is written by the man who had entire charge of the mechanical operations during the period in which this system was being installed, and therefore constitutes a record which should be of interest to American manufacturers at a time when the question of legislative action with regard to the metric system is before us.

In presenting this unusual record of actual performance, MACHINERY does so in the belief that the duty of engineering journals, no matter what their own opinion on a subject may be, is to present to their readers and to the industry that they serve, the actual facts, irrespective of whether these facts appear to prove or disprove the majority opinion among the leading men in the industry.

At the same time MACHINERY wishes to reiterate its opinions expressed in the editorial on the metric system in the April number—"Inches versus Millimeters." Congress should not by compulsory legislation force the metric system—or any system of measurements—upon the industries of the country. The manufacturers should be permitted to decide for themselves upon the system of measurements to be used in the industries they have built up; and until such time as a majority of the manufacturing and engineering associations definitely express themselves in favor of a change, Congress should take no action. If individual manufacturers wish to change from one system to another, they should be at liberty to do so. It is safe to say that if the advantages of a change in the system of measurements can be clearly shown, American manufacturers will not hesitate to change. If the advantages cannot be proved to the satisfaction of the individual manufacturer, his judgment will dictate against the adoption of a new system. As far as MACHINERY knows, all maufacturers in the machine tool field are opposed to a change. In their judgment it would be very harmful to the best interests of the industries. But it is nevertheless the duty of the engineering press to give a fair hearing to facts that are presented on either side of this or any other engineering controversy.

* * *

THE TREACHEROUS SHARP CORNER

Why should it be necessary to repeatedly urge machine designers to avoid sharp corners in machine parts where strength is required? Every good machine designer knows that liberal fillets should be provided; yet they are often omitted, indicating that many designers cannot be placed in the class defined by the word "good." Recently a workman was killed by an accident due to a sharp corner in the bridle of a derrick. A new bridle had been made of heavier dimensions than the original one in order to obtain increased strength; but in making the drawing the designer showed sharp inside corners, and the blacksmith who forged the bridle of course followed the drawing. As a result the new and heavier bridle was not as strong as the old one; for the old bridle, although made to less heavy dimensions, was properly designed with well rounded corners. A crack started at the sharp corner of the new bridle, and when the load came on it, breakage occurred.

The principle in machine design that the sharp corner is treacherous and should be avoided is so well known that it should not be necessary to mention it editorially, or to have it emphasized by a fatal accident. But it seems to be the very familiarity of machine designers with this principle that makes them sometimes forget its application when it would be most important to remember it.

* * *

STANDARDIZING LOCOMOTIVE REPAIR PARTS

The railroads are so absolutely essential to modern social and commercial life that there is widespread interest in ideas for their general improvement. Many different plans have been proposed for securing more economical maintenance and operation, and a recent suggestion intended to effect greater economy in locomotive repair work, reducing the non-productive periods due to disabled equipment, seems worthy of general adoption. The plan, in brief, is first to standardize parts—especially those which often need to be replaced—and then produce these interchangeable parts in a well equipped plant, distributing them, as needed, to different terminal points or wherever broken or worn parts can be replaced.

While finished parts are sent out from the main shops of some railroads, trouble has been experienced in many instances due to lack of adequate standardization. It is necessary to first adopt tolerances based on the functions of the different parts, and then adhere to them strictly, by employing good gaging and inspection methods.

One advantage of the plan referred to is that parts can be produced economically on a large scale in one plant equipped with modern machines and fixtures that would be too expensive for small production. Another great saving would be effected by reducing the time required for repairs, especially when the replacement of one or more parts is all that is necessary. Any plan that facilitates the making of repairs automatically reduces the number of repairs necessary, because the old adage that "a stitch in time saves nine" applies with double force to locomotives.

The Government is to advance $125,000,000 out of the revolving fund of $300,000,000 provided by the Transportation Act for the use of the railways for purchasing rolling stock, and of this amount $50,000,000 is for new locomotives. This new equipment is greatly needed; but there is also need for more modern practice in the maintenance of equipment, particularly the locomotives which are such an important factor in the transportation problem.

Progress or Retrogression?

THE industries of the United States have developed to a greater degree than those of any other country, due chiefly to two things: Our unparalleled natural resources and the reward to individual initiative and industry possible under our institutions. Here any man of energy and capacity may become a captain of industry. As a result, the production of all things necessary to present-day civilization has been greater in the United States, in proportion to population, than anywhere else, and the comforts of life enjoyed by all classes of our people have excelled those of all other countries. We have, and have had, a greater abundance of food, clothing, houses, and luxuries than the great mass of the people in other countries, because our production has been higher per worker than elsewhere; hence, the return to each producer—whether working with brain or with hand—has also been greater.

Unfortunately, this basic reason for the prosperity of our whole nation is not generally understood, and there are powerful forces at work resisting the progress we could still make toward even better conditions. Organized efforts are made to discourage production and limit output. Union labor, in opposing scientific management, bonus and piece-work systems, is trying to limit production in a manner that will ultimately prove harmful to all. Our greatest need is increased production. But the leaders of union labor preach limitation of production, with the result that prices already high mount still higher. The higher wages buy no more goods today than the lower wages of ten years ago bought then; nor will they ever buy more, no matter to what figure they may rise in dollars and cents, unless production is increased so that there is a surplus rather than a scarcity of the goods needed for the comfort and well-being of all.

No greater fallacy has ever been taught labor by their leaders than the doctrine that by limiting production, the union man performs a service to himself. Labor has been led to believe that wages are paid out of an inexhaustible fund and that there is hardly any economic limit to the height to which wages can go, provided the unions are able to make their demands effective. The leaders of labor have never understood—nor been willing to understand—that wages are created out of the products of labor, and that if the product be artificially curtailed, the fund available for wages is thereby decreased. Labor can buy and enjoy only the commodities produced by labor. If there is less of those commodities because of curtailed production, labor's share must be less.

The reason offered by labor leaders for curtailing production is that more opportunities are thus created for the employment of labor—there are more jobs. Temporarily, this may be true, but adjustment to the inexorable operation of economic law is absolutely certain. For a brief period the industries may continue to hire more men to perform the work of a smaller number, but the returns to each worker measured by what he can buy with his wages will be less. Ultimately, the unsound doctrine of curtailed production leads to higher prices, industrial depression and unemployment, and instead of having achieved employment for more men, the result will be unemployment for the great masses of the people.

On the other hand, when production is increased to its highest point, the wages of labor can be raised without any danger to the economic industrial structure, and these wages will buy the maximum of goods, because with greater production, prices fall. The returns to the industries will also be larger, and as the greater part of these returns is reinvested in enlargements to plants and the starting and developing of new ones, employment is provided for all willing to work. As this employment is provided in a natural way, it remains permanent, while the artificial employment produced by curtailing production ultimately leads to the destruction of the industries.

No intelligent employer today objects to high wages, provided they are based upon production. In the modern industrial plant production is the essential thing, and under a bonus or piece-work system the man receiving the highest wages is the most valuable man to the employer.

Union labor must learn to realize this. If not, by its mistaken efforts it will plunge the country into a condition of industrial chaos, and a period of depression during which the workers themselves and their families will be the keenest sufferers. If the labor union leaders, instead of devoting all their efforts to limiting production, creating strife, and hampering the industries, would aid in educating their membership in sound economic doctrines, they would really be working for the welfare of the men and women whom they profess to benefit. Their efforts might then be enlisted for progress instead of retrogression. It is not probable that the present leadership of labor unions is able to do this, and ultimately the rank and file of labor must select new leaders—enlightened men able to comprehend twentieth century methods of economic production. The present leadership of the unions must ultimately pass, for no combination of men can permanently survive if they block our advancing civilization.

Possibilities for Machine Tools in China

By F. A. FOSTER, Peking, China

The author of this article, who is at present on a visit to the United States, has lived in China for the last ten years, and has been engaged in engineering and industrial education in that country during this time. Mr. Foster is a graduate of the Worcester Polytechnic Institute, and a member of the American Society of Mechanical Engineers, as well as a member of the American Chamber of Commerce at Shanghai, China. He is therefore well qualified to speak authoritatively on the subject with which he deals in this article, and his opinions and advice are worthy of receiving most thorough and earnest consideration by American machinery builders.

HAVING returned to the United States for a brief visit after ten years spent in technical educational work in China, I would like to impress upon manufacturers of machinery in general, and upon those making machine tools in particular, that China offers one of the greatest potential markets in the world for machinery of all classes, provided an effort is made to teach Chinese the use and application of machines in the industries and the advantages to be obtained by the employment of modern machines, tools, and methods. Here we have 400,000,000 people, one-quarter of the world's population, highly intelligent, for centuries trained in mechanical arts developed along lines unique to Chinese civilization, eager to learn, and ready to accept the industrial methods and processes of the white race. Further, we deal with a country having unparalleled natural resources—in fact, the time is not far off when some of the important minerals and supplies of the world markets will have to come from China because of the exhaustion of these raw materials elsewhere. Hence, China affords a tremendous market to the machine builders of the world and especially to those of America, because it may be said without question or hesitancy that the Americans have gained the friendship and confidence of the Chinese as has no other foreign nation, and a special opportunity therefore awaits the progressive American manufacturer; but it is necessary for him to take active steps for promoting this trade, for it must be remembered that this potential market is not to be had merely for the asking. Intelligent preparatory work has to precede the actual sales, and some money must be spent along the lines explained in the following, before the full opportunity due to Chinese industrial development can be realized in the trade intercourse between this country and China.

The Fundamental Needs of China

In order to develop the Chinese industries, there are two matters which are of prime importance: One is more adequate means of transportation—that is, more railroads—and the other is technical and engineering education. Little need be said in this article relating to the further needs for railroad communication, because this is a matter which doubtless will be taken care of by the great financial interests and banking circles of this country and Europe. But more needs to be said about providing facilities for technical and engineering education in China, because it is here that the American manufacturer must step in, in order to prepare the market that ultimately will be his if he intelligently cultivates it.

More railroads will, of course, automatically promote other industries in China, but if there is a lack of technically trained men to act as executives and leaders in the industries, progress will be slow. On the other hand, if American manufacturers, through a cooperative movement, would establish engineering schools in China, equipping their laboratories and work-shops with American machinery, the time would not be far off when the results would show in a greatly increased trade in machinery of all classes with China. From the intimate knowledge that I have of Chinese conditions, the general spirit of the times in that country, and the characteristics of the Chinese people, I consider it safe to predict that if a movement of this kind were started now, the results would show themselves appreciably within ten years, and become greater as time passes. Some American machine tool builders have already donated machine tools to Chinese industrial schools, and as a result of these donations orders have already been placed in America for machine tools of similar types for other uses in China. The trade with China in machine tools so far is not great, but it is increasing, and during the month of May over $36,000 worth of machine tools and about an equal amount of other metal-working machinery were imported into China from the United States.

Present Industrial Activities in China

The present industrial activities in China that are of particular interest to the manufacturers of machine tools are the railroad shops and the repair shops in connection with some of the larger industries in other fields. Among the railroad shops one of the larger, if not the largest, is located at Tangshan. This shop employs 5000 men and builds locomotives and cars, as well as doing the repair work for one of the most important of the Chinese railroads. There are many textile mills in China, some of them very large, and these mills must have extensive repair shops, because if anything breaks, there is no opportunity to send to the makers for repair parts because they are thousands of miles away, either in America or in England. The same is the case in the steel mills and at the mines. Chinese industrial undertakings must be prepared to handle all the repair work necessary in connection with their plants while the industries are in their present state of development.

As is well known, Chinese agricultural methods are crude, and few modern implements are employed. There is a tremendous opportunity for the use of agricultural machinery in China, and it is likely that much of this machinery, as well as agricultural implements in general, will be made in China, just as soon as industrial activities along these lines develop. This, in turn, will require large numbers of machine tools. It must be remembered that China is preeminently an agricultural country and that it feeds its 400,000,000 people from its own soil. What the possibilities are in the development of agricultural tools and implements under these conditions is evident even to a superficial observer. The millions of dollars worth of machine tools that will be required in the not very distant future for the factories that will make agricultural machinery and implements is an item not to be passed over without consideration.

In addition to an industrious people and abundant resources in practically every direction, China also has practically limitless supplies of coal, making it possible to develop great industrial enterprises.

The Educational Aspect

If America is to gain the potential machinery trade of China, it is necessary that educational facilities be provided for young Chinese men whereby they may learn to operate

American machinery and to gain an engineering training so that they may become leaders in the industries of their country. Any nation that undertakes this educational work will get a large share of the future trade. France is endeavoring to bring young Chinese men to France in order to train them in the industries, so that when they return to China they will retain friendly trade relations with France. It is proposed to have 6000 young Chinese go to France within the next two years. They will be given an opportunity to learn industrial trades in the factories of France and will then be given a technical education enabling them to return to China equipped to develop her industries.

A plan that has been considered for furthering American interests in China, and that will be helpful to the Chinese, is to establish an American school of mechanical engineering with American capital, equipment, and control, in which Chinese students could get a thorough training in the use of American machinery and methods of manufacture, and, at the same time, have developed in them that power of initiative and self-reliance so necessary to make development work successful. In such a school, particular stress should be put on the practical side of the work.



Fig. 2. Part of Machine Shop in the Chihli Provincial Technical School, Paotingfu, China

Peking University—An American Educational Institution

Peking University, an American institution in Peking, China, has been considering the matter of undertaking some such work, and has worked out some very good plans for such a technical education as will best serve the needs of the country and utilize its various resources. The university has already established a fine school of agriculture as the first and most needed work. A notable feature of this first work is that the Chinese, realizing from their own experience the need of such a school, have donated half a million dollars in financial support, and 1200 acres of land.

Along mechanical engineering lines, the Chinese have not so much experience as in agriculture on which to base similar development work, and will need some American assistance to start them off. Once a good demonstrating start is made by the Americans, there is good reason to believe that the Chinese will come forward with substantial encouragement and financial backing.

In addition to the engineering course, an industrial bureau is proposed, which will study the resources and needs of China and work for the development of new industries. This bureau will work in close cooperation with the engineering department, so that young men will be suitably educated to fill industrial positions in the particular developments under way at any one time.

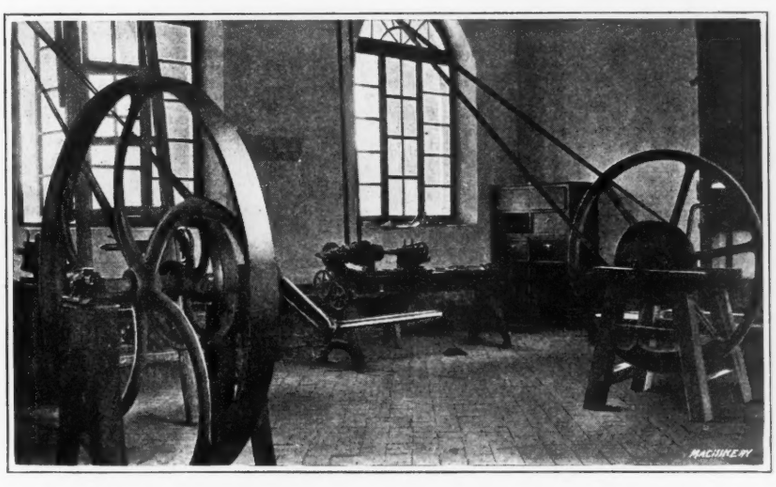


Fig. 1. Small Machine Shop in China, showing Lathes driven by Hand-power. Note Big Flywheels with Handles

This, however, is only a beginning. Engineering education on a much broader scope should be planned for under American auspices. The machine building industries in the United States should, under the auspices of some of the leading manufacturers' associations, endeavor to endow complete technical schools in China, in which the instruction would be along American lines, thereby bringing to life the great potential market that exists in China.

Some Pointers on the Machine Tool Trade in China

In the small Chinese machine shop today one seldom finds anything but simple lathes and drilling machines, often driven by hand; four men work at a large flywheel provided with handles and thereby supply the motive power. In order to create a large general trade in machine tools in China the Chinese must be shown what the modern machine tools can do for them, and that is exactly what the industrial education proposed in this article would do.

In selling machine tools in China, all dealings should be directly between American dealers and Chinese customers, and all shipments, if possible, should be made directly to a Chinese port, preferably Shanghai, which may be termed the New York of China. This is the best place for the location of agencies and a port where simpler lines of machine tools should be kept in stock, as it takes too long a time to order and ship the tools from the United States for each individual sale. Tientsin is also an important port and is destined to become more so in the future. A good deal of American machinery has arrived in China in poor condition because of faulty boxing. It is necessary to box export shipments to China in the most substantial manner.

American machine tool builders have already driven an entering wedge into China by the gifts of machine tools that some of them have made to Chinese industrial and engineering schools. The National Machine Tool Builders' Association has been active in this movement through a committee of which Mr. Broxterman of the John Steptoe Co. in Cincinnati is chairman. Some sales have already resulted from the fact that these machines have been presented to China, because the schools where they are used are really exhibition places where Chinese men of business can see and learn to understand the value of these machines.

It is to be hoped that American machine tool builders will, in the future, equip more of the trade schools in China with modern American machine tools. To the extent that this is done, American manufacturers will insure for themselves a larger share in the great future trade that unquestionably will open up with China in machine tools.

The Metric System in an American Shop

By THEODORE H. MILLER, Works Manager, DeLaval Separator Co., Poughkeepsie, N. Y.

HAVING been at the head of a manufacturing establishment for the past eighteen years in which, during that time, the change has been made from the English to the metric system, I believe that an account of how this was done in an American factory, and what the results have been, might be of interest to many of my fellow shop men who may be seeking light upon the subject and endeavoring, meanwhile, to keep an open mind regarding it. It is a question, which, like others combining mechanical and business or commercial aspects, should be considered with coolness and impartiality; and, above all, both sides of the matter should be examined.

Reasons why DeLaval Separator Co. Changed to Metric System

In our case there were special reasons for looking into this question—reasons that would not apply in all cases. Our intimate connection with a manufacturing establishment in Sweden, making a similar machine there for the European market, made it important for us to be able to visualize measurements and quantities stated in metric terms and to be able to readily read and thoroughly comprehend drawings made to the metric system. In other words, it became almost imperative that the two establishments, the one in Sweden and the other here, should use—in their correspondence and on their drawings—the same system of weights, measurements, and capacities. For reasons not necessary to go into here, it would have been unthinkable for us to have asked our Swedish friends to change to our system, and so we considered whether we ought not to change to theirs, and finally did so, without any of the tremendous difficulties and enormous expenses that we hear so much about.

How the Change was Accomplished

Our machines are manufactured in very large numbers in a thoroughly organized factory, equipped to a rather unusual extent, I think, with expensive and highly refined special tools and machines. If our change to the metric system had meant throwing these away and making new ones having integral metric measurements, the task would have been practically impossible; but we did not need to do this. We simply adopted metric measurements for the machines we were already manufacturing; we put metric dimensions on the drawings for these machines and for the tools used in manufacturing them, as fast as circumstances called for it to be done, and commenced to talk millimeters and hundredths of a millimeter, instead of inches, eighths, sixteenths, thirty-seconds, sixty-fourths and thousandths of an inch. We did the same with units of weight and capacity. It was all very simple, and after a short time almost everyone about the place was using the new terms with the greatest ease and familiarity.

Whether the change from one system to the other can be made quickly or not, depends upon what we mean by the change. I claim that when we quit talking about our machines and tools in English terms and commenced to talk of them in metric terms, our factory had made the change. It removed all the difficulties mentioned at the beginning of this article and it introduced no new ones not easily overcome. The expense was slight and never showed itself to any appreciable extent in the factory cost of our machines; and we think we know costs about as accurately as anyone does. This change took place twelve years ago and we have seen no reason whatever to regret having made it. On the contrary, it has been advantageous to us in every way.

When we design a new model of our line of machines or a new size we shall probably make some, and perhaps all, of the dimensions, to what may be called integral metric sizes, that is, even millimeters so far as possible; but, regardless of how far our judgment may lead us to go in that direction, we shall certainly define all dimensions in metric terms. It is my belief that others who follow that plan will find the change very easy and the results favorable.

This experience has been all the more interesting to me, as I was brought up and educated in the English system and spent fifteen years, previous to becoming engaged in executive work, as an apprentice, toolmaker, gage-maker, and shop foreman, working exclusively to the English system of measurement, except for a period of six months spent in Mexico.

The Changing of Drawings

When the change was made at the plant of the De Laval Separator Co., a carefully planned course was pursued, and no confusion resulted. Dimensions in millimeters were placed on the old drawings directly under the inch dimensions. On new drawings the inch dimensions were omitted, all dimensions being in millimeters, so that gradually the inch measurements disappeared from all drawings. No difficulty has been experienced by inability of the men to work to the metric units, except in case of a man who may have so thoroughly absorbed the English units and become so mentally inelastic, that he is unable to read a drawing or take a measurement except in terms of English units of length; but this is a rare case, especially among young or middle-aged men. As soon as the men are able to forget the existence of the inch and its fractions, the metric system becomes extremely simple. It is only when a needless attempt is made to translate one system into another that confusion arises, and the workman's inclination to do this should be discouraged.

In a large industrial plant working under the metric system in America, some difficulty is, of course, experienced in the purchasing department, owing to the fact that it is impossible to buy certain materials, such as square, round, or flat bar stock, for example, in other than inch measurements and sizes. This difficulty is also encountered in other cases during the process of manufacturing, owing to the use of English units of measure outside of the plant.

The Likelihood of Making Errors

It has been said that the use of the decimal point increases the possibility of error. I firmly believe that errors caused by the omission or transposition of decimal points are not so frequent as those caused by changing fractions of an inch into decimals. If the use of decimals were objectionable or likely to cause errors, they would be particularly objectionable in high-grade gage and tool work. But, even in the English system, limits are always expressed in decimals of an inch in work of that kind, often to four, or even five, places; yet errors due to that source rarely occur. These errors are still further reduced when the metric system is used, because the same degree of accuracy is expressed with fewer figures. From an experience of twelve years, I can say without hesitation that the change from the English to the metric system of measurement has, in the case of the De Laval Separator Co., proved an economical measure, for after once being established, fewer errors have been made in interpreting drawings and making calculations.

The Question of Patterns, Gages, and Tools

The adoption of the metric system will not necessitate the wholesale scrapping of patterns, gages, or machine tools. Any practical mechanic, after a little reflection, should, I think, understand this. The experience of the De Laval Separator Co., in changing from the English to the metric system bears this out, for in the shop today many of the machines and much of the equipment are still the same as when the English system was in use, and no machines have been discarded on account of the change. It is not the dimensions of the work that are changed at first, but simply the nomenclature pertaining to the sizes. It is of little importance to the workman, especially when engaged in production work, whether a gage is dimensioned in thousandths of an inch or in hundredths of a millimeter, for he need not often refer to the drawing, but is interested mainly in whether or not the work comes within the limits of the gage. When gages, tools, and fixtures are to be replaced because of wear or from other causes, the new equipment is made to the new system of measurement. By following this gradual transformation practice, no extra expense has resulted from the introduction of the metric system in our factory.

Patterns are foundrymen's tools, and the system of measurement to which they are made is of minor importance. There has never been a case where it has been necessary to discard one of our patterns because it was made to the English system, even though the machined surfaces later were machined to metric measurements; nor has there been any difficulty in the use of the machine tools made to the English system, as they are employed equally well for finishing machine parts dimensioned in the new system; and no gages have been thrown away at any time because of the change from one system to another. The men have been found to read metric scales and micrometers more easily than those made to the inch system. In the case of scales and micrometers, of course, there is an initial added expense, as in this case the old tools must be replaced with new. This has been done gradually, so that at the present time in the De Laval plant all micrometers, scales and other graduated instruments read in the metric system.

The Author's Conclusions

Through the actual use of the metric system in a large manufacturing plant, although during fifteen years of work in the industries I had little practical experience with any but the English system, I have come to believe in the advantages to be gained through the adoption of the metric system. I do not believe that because the English system has always met the practical needs of the industry in the past, it should, therefore, not be disturbed. It would be equally logical to say that an old type machine should not be replaced by a modern one, because the older machine had always met the needs of the work of the plant in the past, and that, therefore, a modern machine of greater efficiency should not be installed.

On the basis of the experience of the De Laval Separator Co., it is, therefore, safe to draw the following conclusions: (1) The change to the metric system can be made without causing confusion, or serious disturbance. (2) It is unnecessary to throw away patterns, gages, or tools made to the old system. (3) The simplicity of the metric system is the greatest factor in its favor, and due to its use, there has been a reduction of errors.

I believe that we have adopted and are using the metric system as fully as any conceivable legislation that could be enacted and enforced in this country could require; but, irrespective of the wisdom or unwisdom of compulsory legislation on this question, possibly the experience of the Swedish company to which I have referred might be of interest. Erik Forsberg is the chief engineer of the Swedish company. He has been much in this country and is quite familiar with our system of measurements. He has recently left here for home, after an extended visit, and speaking of the experience with the metric system in his country, he said: "When legislation was enacted there compelling the use of the metric system, ten years' time was given in which to accomplish the change. The manufacturers and others seemed to care nothing at all about the legislation or the ten years' time, or anything in connection with it, but simply went on with their old system until something more than nine years had elapsed when there was a grand scramble, which resulted in the metric system coming into use rather suddenly, but fully, and with astonishingly little confusion."

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ERRORS IN SCREW THREAD TOLERANCE DATA

The original tables of screw thread tolerances, as furnished by the National Screw Thread Commission and published in the July number of MACHINERY in conjunction with the article "Allowances and Tolerances for Screw Threads," contained a number of errors which have later been corrected by the commission according to the following list:

Table 6: No. 3 screw size, minimum major diameter, 0.0919 instead of 0.0881; 9/16-inch screw, maximum pitch diameter, 0.5060 instead of 0.4960; minimum pitch diameter 0.4981 instead of 0.4881; and minimum minor diameter 0.4439 instead of 0.4339. The following corrections for screw sizes from 5/8 inch to 3 inches, inclusive, apply to the minimum minor diameters; 5/8 inch, 0.4958 instead of 0.4998; 3/4 inch, 0.6081 instead of 0.6125; 7/8 inch, 0.7176 instead of 0.7225; 1 inch, 0.8231 instead of 0.8287; 1 1/8 inches, 0.9231 instead of 0.9295; 1 1/4 inches, 1.0481 instead of 1.0545; 1 1/2 inches, 1.2646 instead of 1.2712; 1 3/4 inches, 1.4681 instead of 1.4773; 2 inches, 1.6872 instead of 1.6976; 2 1/4 inches, 1.9372 instead of 1.9476; 2 1/2 inches, 2.1484 instead of 2.1601; 2 3/4 inches, 2.3984 instead of 2.4101; 3 inches, 2.6484 instead of 2.6601. The maximum pitch diameter for the 9/16-inch nut should be 0.5163 instead of 0.5183.

Table 7: No. 10 screw size, maximum major diameter, 0.1889 instead of 0.1899, and minimum major diameter 0.1813 instead of 0.1823; 7/8-inch screw, maximum major diameter 0.8729 instead of 0.8629, and minimum major diameter, 0.8589 instead of 0.8489; 1 1/2-inch screw, minimum major diameter 1.4818 instead of 1.3818; 3-inch screw, maximum pitch diameter, 2.9322 instead of 2.9332, and minimum pitch diameter, 2.9230 instead of 2.9240. Nut for 3/8-inch screw, maximum pitch diameter, 0.3525 instead of 0.3425.

Table 8: 2 1/4-inch screw, minimum minor diameter, 1.9486 instead of 1.9386; 3-inch screw, minimum pitch diameter, 2.8236 instead of 2.8276. Nut for 3/8-inch screw, maximum major diameter, 0.3885 instead of 0.3895.

Table 10: Nut for 3/8-inch screw, maximum major diameter, 0.3872 instead of 0.3862; nut for 2 3/4-inch screw, maximum pitch diameter, 2.5973 instead of 2.6973.

Table 15: Nut for No. 5 screw, maximum major diameter, 0.1291 instead of 0.1289.

* * *

As many foreign-born workers have been returning during the last year and a half to their native countries, ignorant of the present conditions in Europe, an information service bureau for the benefit of these men has been established by the Inter-racial Council in the Woolworth Building in New York City. The object of the bureau is to distribute such information relating to the present conditions in the European countries as will check the tendency of the foreign-born population to return under the mistaken impression that prices are lower and living conditions better than in America. This information is spread mainly through the foreign language newspapers by sending them reports from unbiased sources relating to the actual conditions abroad. Employers of foreign labor will be interested in this information service, and may obtain from the bureau for distribution among their employes much valuable information.

Machine Tool Situation in Sweden

By OSCAR LINDBOM, President, Aktiebolaget Oscar Lindbom, Stockholm, Sweden

The author of this article has been in the United States for the last six weeks studying the conditions in the machine tool industry and making arrangements for representing American manufacturers in Sweden. Mr. Lindbom recently took over the machine tool department of the Galco, Ltd., in Stockholm. He is an engineer by education and training and has had several years' experience in machine building plants, both in the shop and as a designer. About ten years ago he turned to the commercial side of the field, and has since been engaged in selling machine tools in Scandinavia. Hence, he is exceptionally well informed upon the subject dealt with in this article, and his review of the machine tool situation in Sweden is of especial interest.

THERE has been a considerable change in the machine tool situation in Sweden in the last six months. During the whole of 1919 the German competition was exceptionally strong, German manufacturers selling at extremely low prices in the Swedish market. As a result, the Swedish machine tool builders had to reduce their output, and placed most of what they made in stock. Nor could any American machine tools imported at that time be disposed of. During the period when German machine tools were sold so cheaply, many manufacturers and dealers fully equipped themselves to take care of both present and future requirements; this is one reason why the machine tool business up to the present has not been as brisk as it would have been otherwise.

At present, the German competition is less formidable, because, while the German makers still sell their machines and tools from 10 to 20 per cent cheaper than Swedish or American manufacturers, their deliveries are very uncertain and buyers, therefore, show much less interest in German offerings. This makes it possible for the Swedish manufacturers of machine tools to sell in their home market, and even for export; but the importation of American machine tools is still difficult on account of the exchange situation which virtually increases the price of American machine tools in Sweden by somewhat more than 20 per cent.

Machine Tools that can be Sold in Sweden

Notwithstanding the exchange situation, it is possible to sell in Sweden such machine tools as are not being built there or in which Swedish makers cannot compete with the American product. These machines include types of high quality and productive capacity, and especially automatic and semi-automatic manufacturing machines; automatic screw machines; multiple-spindle drilling machines; grinding machines; universal milling machines; gear-cutting machines; and certain sizes of vertical boring mills and turret lathes. The classes of machine tools that are difficult, if not impossible, to sell in Sweden, because they are manufactured by Swedish makers, are especially, engine lathes, ordinary types of drilling machines, small plain milling machines, plain grinders, small and medium-size horizontal boring machines, shapers, and planers. As an example indicating why it would be impossible to sell American shapers in the Swedish market it may be mentioned that a 22-inch shaper of good quality, adjustable stroke, weighing 2700 pounds, is sold by a Swedish manufacturer for Kr. 2400, which at the present rate of exchange—twenty-two cents to one krona—is $528.

Small Tool Situation

There are several manufacturers in Sweden making both high-speed and carbon steel drills. The prices quoted by Swedish makers are in some instances slightly less than those for American tools, but on the whole the prices are about equal. It is possible to import the American product when it originates from the best known makers of small tools, because many of the Swedish shops want them. The prices of both American and Swedish high-speed steel drills are higher than those quoted by English drill manufacturers, and as a result many English high-speed steel drills are sold in Sweden.

In regard to taps and reamers, the situation is somewhat different. There is less English competition, and it is easier for the American product to compete with the Swedish tools. In drills, taps, and other small tools, however, the German competition is strong. These tools are still being imported from Germany at lower than world market prices; and last year many Swedish shops and dealers laid in tremendous quantities of these tools for future use on account of their cheapness. At present, the export prices fixed by the German Government prevent the selling of German tools at the former low price, but the export prices are fixed in accordance with the world's markets and are always from 10 to 20 per cent lower.

The Exchange Situation and Credits

The reason why the Swedish exchange is low is simply that at the end of the war Sweden found itself with depleted stocks in every possible direction and had to import enormous quantities of raw materials. As a result the exchange fell. Normally, one krona is equal to twenty-seven cents. It fell to a point slightly less than eighteen cents but has advanced again to about twenty-two cents. Just as soon as Sweden gets an opportunity to export more of the products for which the world's markets have need—especially iron, paper, and wood pulp—there will be an improvement in the exchange situation. Until that time the American manufacturer ought, whenever possible, to grant an export rebate in order to make it easier to sell. In the writer's opinion the improvement in the exchange situation will be steady from now on, and as it improves it will become easier to sell American machine tools in Sweden, provided American bankers do not permit their estimate of the Swedish currency to be influenced too much by the situation in eastern Europe—Russia and Poland.

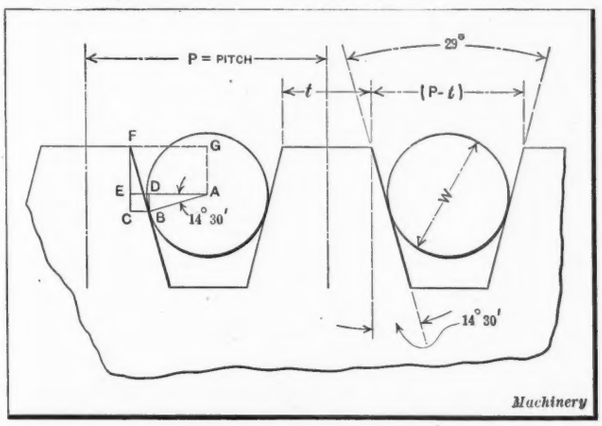
The credit situation is another important item. Most American manufacturers demand payment for machine tools before they leave New York, which means that they must be paid for several months before they are placed in the shop of the customer and begin to produce. Swedish manufacturers give their customers from thirty to ninety days' credit from the time of shipment; this means that the machine will produce for a period of from two to ten weeks before it has to be paid for. This naturally increases the difficulty in selling American machines. In order to sell at all, the agent of the American manufacturer often must extend credit himself to his customer.

As a remedy for this condition the writer proposes that in order to guarantee the payment to the American manufacturer, arrangements be made between his American bank and the Swedish bank of the customer, by which the American manufacturer would be guaranteed payment ninety days after actual shipment from New York. This method of handling export trade would greatly aid in increasing Scandinavian sales.

THREE-WIRE SYSTEM FOR MEASURING STANDARD WORM THREADS

By H. A. PEARSON

The pitch diameter, which is the most important dimension of a worm thread, can be measured either by the use of ball-point micrometers or by the three-wire system. Of the two methods, the three-wire system is generally considered the more accurate, but machinists frequently find it inconvenient to use the regular three-wire system, as it requires special wires. Nearly all handbooks give the size of special wires for measuring worm threads of various pitches, but very little information is to be found relative to the problems encountered in measuring worm threads with wires of any size other than those specified.



Enlarged Section of Standard Worm Thread showing how Wires of Any Suitable Diameter can be used to measure the Pitch Diameter of the Worm Thread

In the following is given the derivation of a general equation which can be applied when using wires of any suitable diameter to measure the pitch diameter of a standard 29-degree worm thread, the only restrictions being that the wires project above the top of the thread or come flush with the outside diameter, and that they be in contact with the sides of the thread. Referring to the enlarged section of a standard 29-degree worm thread shown in the accompanying illustration, P = pitch; t = width of thread at top; $(P-t)$ = width of opening at top; and O.D. = the outside diameter of the worm. Now, having given the width of opening $(P-t)$, the diameter W of the wires, and assuming that the thread angle is correct, the first step in solving the problem becomes simply a matter of expressing, in the form of an equation, the relationship between AG and the two known dimensions W and $(P-t)$.

Again referring to the illustration, it is evident that $AG = EF$ and that EF is the distance from the center of the wire to the outside of the worm thread. It is also seen that $AG = CF - BD$; $CF = BC$ cot 14 degrees 30 minutes; $FG = \frac{P-t}{2}$; and $BC = \frac{P-t}{2} - AD$.

Now

$$AD = AB \times \cos 14 \text{ degrees } 30 \text{ minutes}$$

$$BC = \frac{P-t}{2} - AB \cos 14 \text{ degrees } 30 \text{ minutes, or}$$

$$BC = \frac{P-t}{2} - \frac{W}{2} \cos 14 \text{ degrees } 30 \text{ minutes}$$

Therefore,

$$AG = \left(\frac{P-t}{2} - \frac{W}{2} \cos 14 \text{ deg. } 30 \text{ min.}\right) \times \cot 14 \text{ deg. } 30 \text{ min.} - \frac{W}{2} \sin 14 \text{ deg. } 30 \text{ min.}$$

The micrometer measurement taken over the three wires in the usual way $= 2\,(AB - AG) + \text{O.D.}$, which is equivalent to

$$2\left(AB - \left[\left(\frac{P-t}{2} - \frac{W}{2} \cos 14 \text{ deg. } 30 \text{ min.}\right) \times \cot 14 \text{ deg. } 30 \text{ min.} - \frac{W}{2} \sin 14 \text{ deg. } 30 \text{ min.}\right]\right) + \text{O.D.}$$

Now substituting values of sine, cosine, and cotangent, the micrometer reading equals:

$$2\left(\frac{W}{2} - \left[\left(\frac{P-t}{2} - \frac{W}{2}\,0.9681\right)3.8666 - \frac{W}{2}\,0.2504\right]\right) + \text{O.D.}$$

Simplifying and uniting terms, this equation becomes

$$\text{Microm. measurement} = 4.9937\,W - 3.8666\,(P-t) + \text{O.D.}$$

This is the general equation for three-wire readings, and from this equation it is evident that the value of the second term always depends upon the pitch of the worm thread. Therefore, this method of measuring the pitch diameter can be further simplified by preparing a table of constants such as given in the accompanying table. From this table the values 3.8666 $(P-t)$ can be readily substituted in a formula for any specific case within the range covered by the table. The following example will show the method of using: Suppose, for instance, that it is desired to obtain the micrometer reading for a worm thread having 4 threads per inch. Substituting the values from the table, we have:

$$\text{Micrometer measurement} = 4.9937W - 0.6426 + \text{O.D.}$$

The table can be extended to include any pitch desired, and it is of such simple form that it should prove valuable to any machinist who finds it necessary to test the accuracy of standard worm threads, as it involves only simple mathematical operations. The accuracy of the results obtained by this method can be easily verified by comparison with the measurements given on page 1035 of MACHINERY'S HANDBOOK, for use when employing wires of special size. As an example, let a worm having 4 threads per inch and an outside diameter of 1 inch be arbitrarily chosen. Using wires 0.1287 inch in diameter, the micrometer reading would equal $4.9937\ (0.1287) - 0.6426 + 1.000 = 1.000$. From this it is evident that the wire comes flush with the outside diameter of the screw, thus verifying the accuracy of the derived equation.

TABLE USED TO MEASURE PITCH DIAMETER OF STANDARD WORM THREADS BY THREE-WIRE METHOD

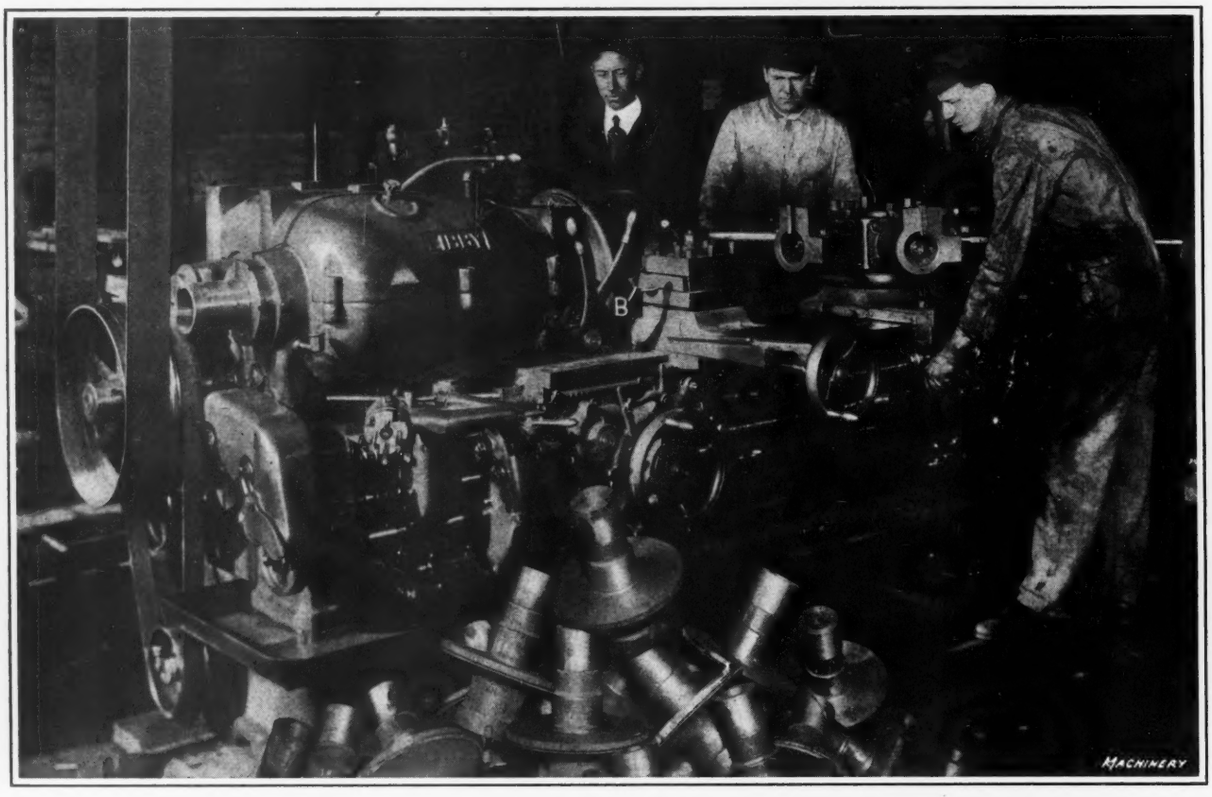
No. of Threads per Inch	Pitch P	Thickness t	(P—t)	3.8666 (P—t)
1	1.0000	0.3354	0.6647	2.5701
1½	0.6667	0.2236	0.4431	1.7133
2	0.5000	0.1677	0.3323	1.2849
2½	0.4000	0.1341	0.2659	1.0281
3	0.3333	0.1118	0.2215	0.8567
3½	0.2857	0.0958	0.1899	0.7342
4	0.2500	0.0838	0.1662	0.6426
5	0.2000	0.0671	0.1330	0.5140
6	0.1667	0.0559	0.1108	0.4284
7	0.1429	0.0479	0.0950	0.3671
8	0.1250	0.0419	0.0831	0.3212

Machinery

* * *

USING FREIGHT CARS FOR MOVING AND NOT FOR STORING FREIGHT

If freight cars were really used to move freight rather than to store freight, the freight situation would not be half as bad as it is. The Material Handling Machinery Manufacturers' Association points out that the 2,452,000 freight cars in the United States move only 9 per cent of the time. Loading and unloading each takes about 11.5 per cent of the time. The remaining 68 per cent of the time is really wasted, due to keeping cars a longer time than necessary before unloading and also to switching and yard delays. If everyone concerned in the use of freight cars did his best to see that the cars were kept moving as much as possible, and if the combined efforts saved only one hour a day in the case of each car, the economy would equal the 102,000 cars it is said our railroads are short of in their equipment.



Libby Turret Lathe Practice

Tooling Equipment Employed by the International Machine Tool Co., Indianapolis, Ind., in Machining Work on the Libby Turret Lathe

A SERIES of articles discussing the practice of performing those classes of machining operations that can be advantageously done on turret lathes would be incomplete without mention of the results obtained in handling such work on Libby turret lathes manufactured by the International Machine Tool Co., Indianapolis, Ind. Acknowledgment is made to the engineering staff of this company for the cooperation that was extended in the collection of data which forms the basis of this article.

Machining Malleable Iron Wagon Hubs

At the plant of the St. Louis Malleable Castings Co., St. Louis, Mo., the machine shop is called upon to finish malleable iron hubs for military escort wagons. These hubs are of the form shown lying on the floor beside the machine in the heading illustration, and outlined in Figs. 2 and 3 in the chucks which are employed to hold them while the required machining operations are being performed. To any experienced turret lathe operator it will be evident from the form of the work that two series of operations are required to finish these hubs. The heading illustration shows a lathe equipped for the performance of the first series of operations, and in Fig. 2 is illustrated one of the special tool-heads used for facing, with the work outlined in its proper relation to the tools. For handling this part of the work, a three-jawed chuck is employed, which has hardened jaws *A* to grip the flange as indicated in Fig. 2.

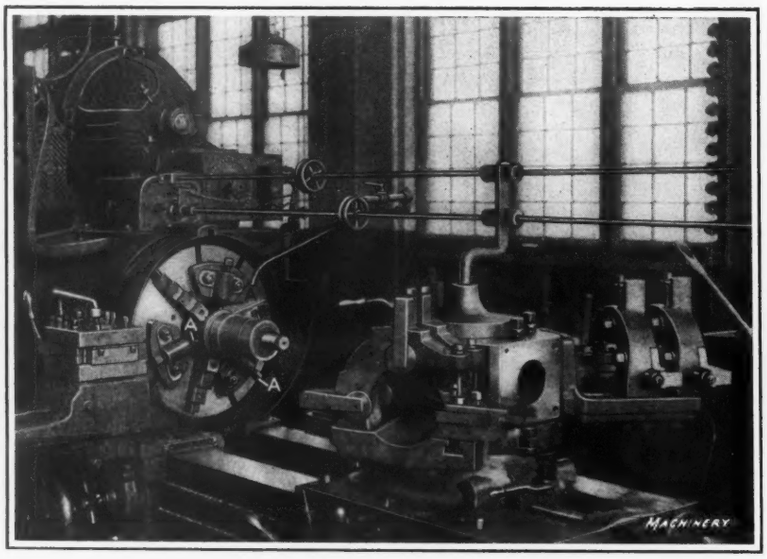


Fig. 1. Turret Lathe equipped for making Locomotive Cross-head Pins from Old Car Wheel Axles

Prior to starting the regular sequence of operations, a roughing tool *B* on the cross-slide (see heading illustration) is employed to remove the oxide scale from those surfaces which are to be finished by the first series of operations, the purpose being to protect the regular tools mounted on

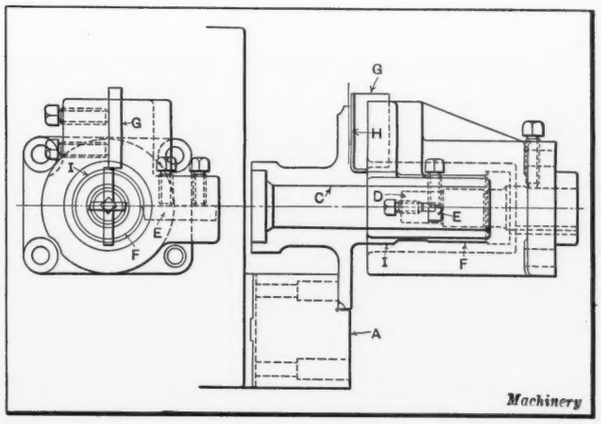


Fig. 2. Turret Tools for turning Two Hub Diameters and facing Flange

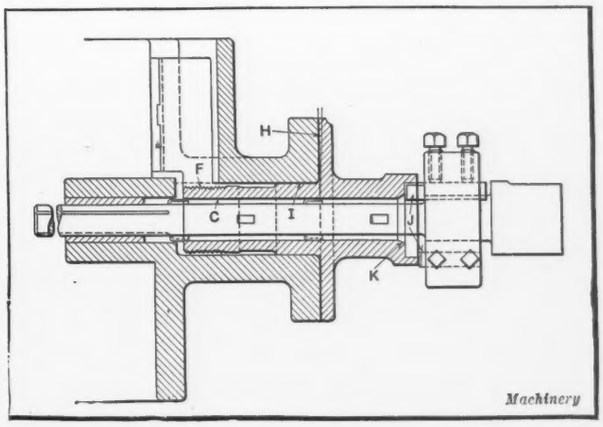


Fig. 3. Turret Tool for boring and counterboring Hub at Second Setting

the turret from the rapid dulling action of this hard scale. After taking this preliminary cut, the regular sequence of operations for the first set-up is as follows: (1) Start boring cored hole *C*, Fig. 2, with a boring-bar *D*, arranged with a follower pilot to run in the freshly bored hole and maintain alignment. The cut to be taken in bore *C* is of considerable length, and while this part of the work is in process, tool *E* is also engaged on the outside of the work turning diameter *F*, and tool *G* is used in facing the tapered surface *H* and in turning diameter *I*. All of the tools used for this operation are arranged in a combination holder. (2) At the second station on the turret there is a similar tool to the one which has just been used, this tool being arranged to perform finishing operations on those surfaces which have just been roughed out, but in this case a pilot is provided to enter the bored hole *C* ahead of the tools, to provide for maintaining them in accurate alignment. (3) On the third station of the turret a Geometric die-head is provided for threading diameter *F* on the work. This completes the first sequence of operations. The operations performed at the second setting will now be described.

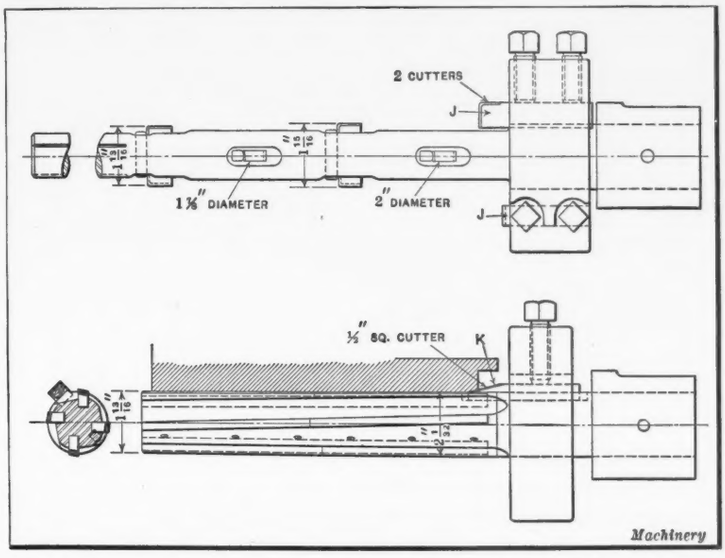


Fig. 4. Stepped Boring-bar and Tapered Reamer for Operation in Bore of Hub

After completing the first series of operations as described, the work is reset in a turret lathe equipped with a pot fixture on the chuck, as shown in Fig. 3, having threaded jaws into which diameter *F* of the work is screwed to bring tapered surface *H* back against a corresponding surface of the pot fixture. Referring to the tool set-up shown in this illustration, it will also be evident that diameter *I* enters the bore of the pot fixture, in which it is a tight fit. With these three locating surfaces all utilized to hold the work, assurance is obtained that an accurate setting and adequate support will be obtained. With the casting located in this manner, the sequence of operations to be performed is as follows: (1) Bore hole *C* to approximately the desired taper; a four-stepped cutter-bar is used, being fed through a distance equal to one-fourth the length of the work, so that the hole *C* is divided up into four sections of slightly different diameters. The boring-bar used for this purpose is shown in detail in the upper portion of Fig. 4, where it will be seen that each of the four cutter-bits varies by 1/16 inch from the size of adjacent cutters, and that there are also two cutters *J* on the bar to provide for counterboring

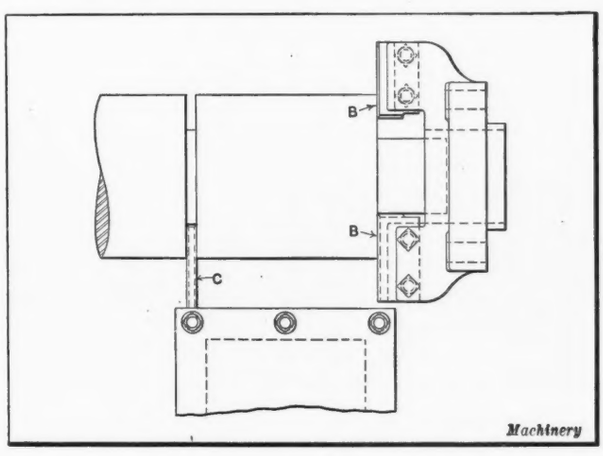


Fig. 5. Cutter-head for roughing down End of Cross-head Pin

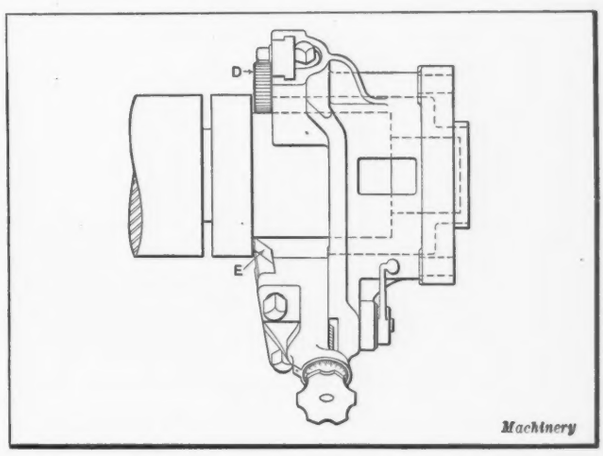


Fig. 6. Bar-turner for rough-turning Body of Cross-head Pin

and facing the end of the hub. This bar is piloted into a bushing in the pot fixture. (2) The next step is to ream the four-stepped hole *C* produced by the boring-bar, with a nicked roughing reamer, which also provides for cutting the chamfer *K*. (3) On the third station of the turret there is a reamer which provides for finishing bore *C* in the work. This reamer is shown in detail at the bottom of Fig. 4, where it will be seen that there is a tapered section at the rear end of the reamer to provide for finishing chamfer *K* on the work. On this job the rate of production obtained is one casting every eight minutes, which is the time taken for completing all the operations that are performed during the two settings of the work.

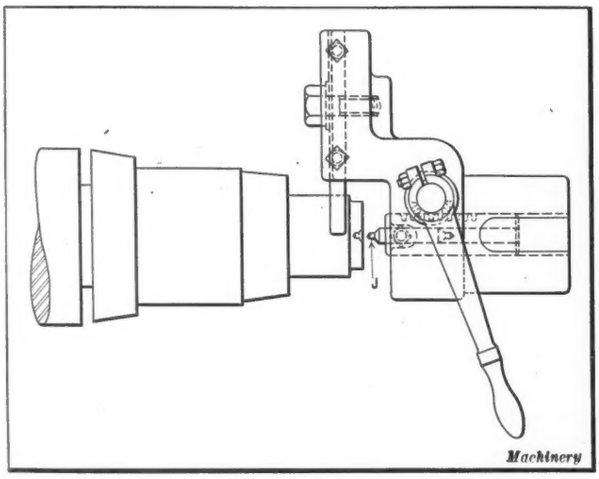


Fig. 7. Centering Tool for drilling the Center Hole in Cross-head Pin

tween each pair of jaws, to enable concave-pointed set-screws *A* to be turned down into contact with the work, the concave point of these screws biting into the work and gripping it securely.

On this job the order of operations to be performed is as follows: (1) Rough down the end of the work with a cutter-head, Fig. 5, that has two blades *B*, each of which takes one-half of the cut. While this operation is in progress, a parting tool *C* in the cross-slide turret toolpost starts cutting off the work. (2) On the second face of the turret there is a bar-turner, Fig. 6, that provides for taking a roughing cut to reduce the work to the form shown, this tool being furnished with a roller back-rest *D* to hold the work against the cutter *E*.

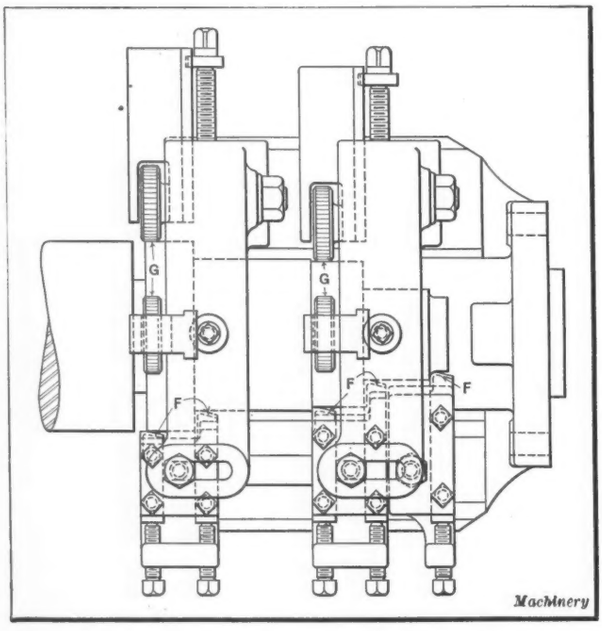


Fig. 8. Box-tool for finish-turning Five Diameters on Cross-head Pin

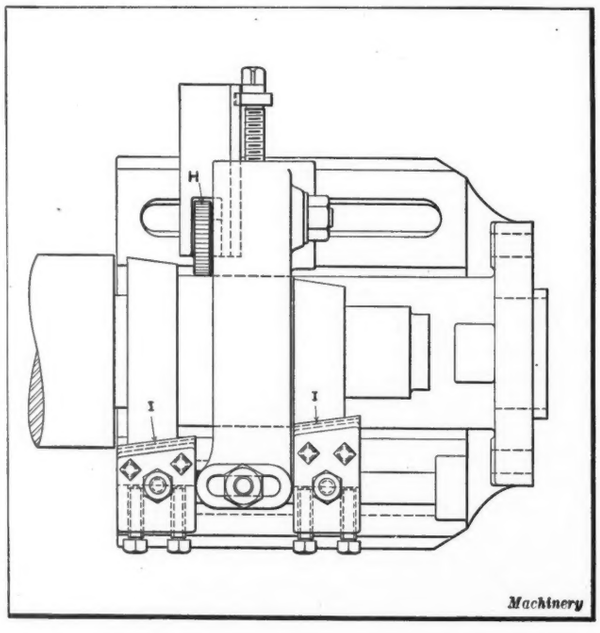


Fig. 9. Box-tool for finish-turning Tapered Surfaces on Cross-head Pin

Making Locomotive Cross-head Pins from Old Car Axles

With a view to utilizing material which would otherwise be discarded, and also because experience has shown that this steel gives unusually satisfactory results owing to thorough seasoning of the metal, the Altoona shops of the Pennsylvania Railroad, at Altoona, Pa., make a practice of using discarded car wheel axles for making locomotive cross-head pins. Fig. 1 illustrates a Libby turret lathe set up for performing the first sequence of operations on this job, and Figs. 5 to 10 inclusive show the tools provided for operation on the work while it is mounted on the machine. Referring first to Fig. 1, it will be seen that the work is held in a three-jaw chuck and that special brackets are mounted on the faceplate be-

(3) Next in the order in which tools are used on this machine comes a box-tool Fig. 8, with five blades *F* that are used for taking a finishing cut, and it will be seen that there are roller back-rests *G* to hold the work against the tools. (4) A finishing box-tool, Fig. 9, with roller back-rest *H* is now employed, which has tapered blades *I* to provide for finishing the inclined surfaces on the work. (5) The next operation is to drill the center hole with a centering tool *J* shown in Fig. 7. (6) At the sixth station there is a Geometric die-head *K*, Fig. 10, that provides for threading the nose of the work. After this operation has been completed, the parting tool *L* in the turret toolpost on the cross-slide completes cutting off the finished pin from the bar. The time required for the entire series of operations is twenty-three minutes.

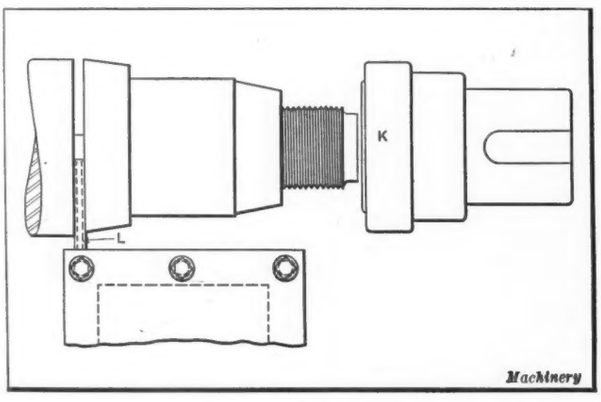


Fig. 10. Geometric Die-head for threading Outer End of Cross-head Pin

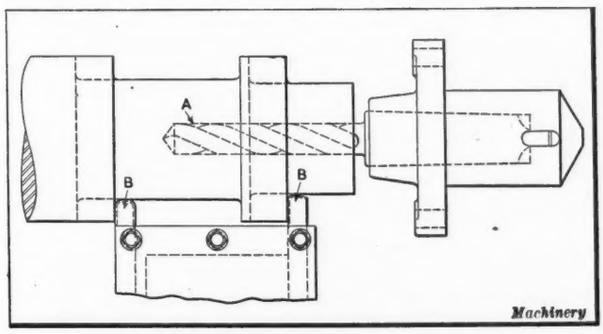


Fig. 11. Drilling Hole with Turret Tool and Rough-turning with Tools mounted on the Cross-slide

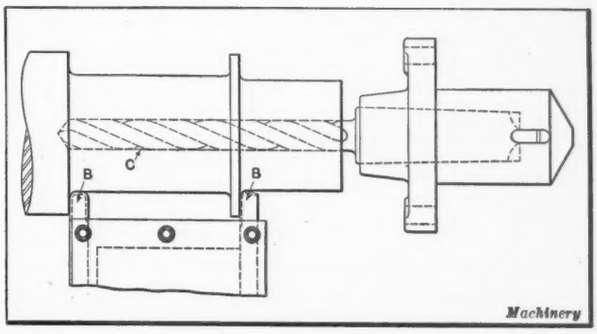


Fig. 12. Completing the Work of drilling from the Turret and turning with Tools on the Cross-slide

Method of Machining Locomotive Crankpins

Figs. 11 to 16, inclusive, show tools for the performance of a sequence of operations on a locomotive crankpin that is machined in the Pennsylvania Railroad Shops at Altoona. As in the preceding case, the work is held by a three-jaw chuck, with set-screws located between the chuck jaws to assist in holding the work. (1) This type of crankpin is hollow, and on the first station of the turret there is a twist drill *A*, Fig. 11, which provides for roughing out the hole part way through the work. During the time that this operation is being performed, two turning tools *B* carried by a turret toolpost at the front of the cross-slide are engaged in rough-turning the outside diameter of the work. (2) On the second station of the turret, a twist drill *C*, Fig. 12, completes drilling the hole that was started by a drill on the preceding turret face; and the same tools *B* carried by the turret toolpost on the cross-slide complete rough-turning the outside diameter of the work. (3) The third station of the turret carries a chucking reamer *D*, Fig. 13, which finishes the hole that has just been drilled; and conforming with usual practice, no other tools are working on the piece while this reaming operation is in process, owing to difficulty which might be experienced in holding the bore to the required size if such a practice were followed. (4) Next in the order of operations comes rough-counterboring the end of the crankpin with a tool *E*, Fig. 14, carried on the next face of the turret; and while this operation is in progress, a tool *F* carried on the cross-slide turret toolpost is utilized to finish-turn the back part of the crankpin. (5) On the next station of the turret there is a counterbore *G*, Fig. 15, which completes the operation started by tool *E* on the preceding face of the turret. While this work is being done, the cross-slide tool *F* completes finish-turning the back part of the crankpin. (6) A box-tool, Fig. 16, with two cutters *H* and roller back-rests *I* is next utilized for finish-turning the outside of the work at the forward end, and a parting tool *J* on the cross-slide cuts off the crankpin from the bar, thus completing the sequence of operations.

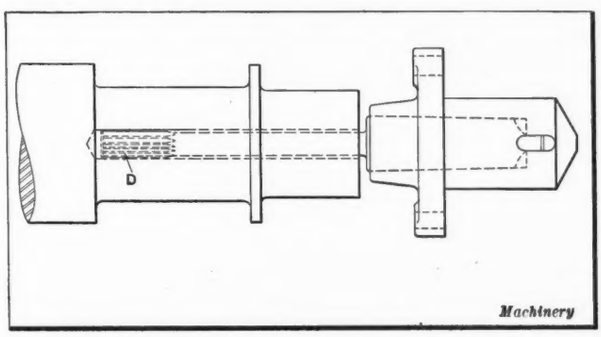


Fig. 13. Reaming the Hole through the Crankpin with a Tool mounted on the Turret

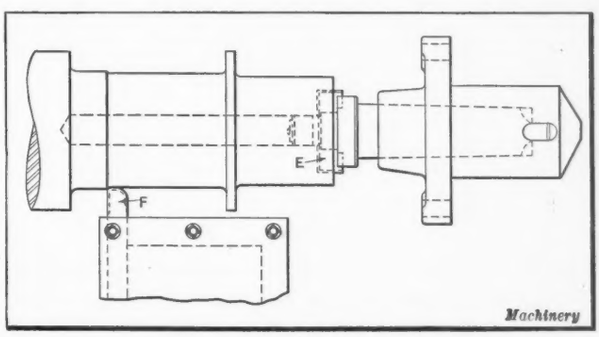


Fig. 14. Rough-counterboring with Turret Tool and finish-turning with Cross-slide Tool

Turret Lathe Operations on Differential Gear Housings

At the H. J. Walker Co.'s plant in Cleveland, Ohio, Libby lathes are used for performing a sequence of operations required in the manufacture of malleable-iron differential gear housings. To provide for holding these irregular shaped pieces of work, a pot fixture with three adjustable clamping points is mounted on the lathe head to supplement the three-

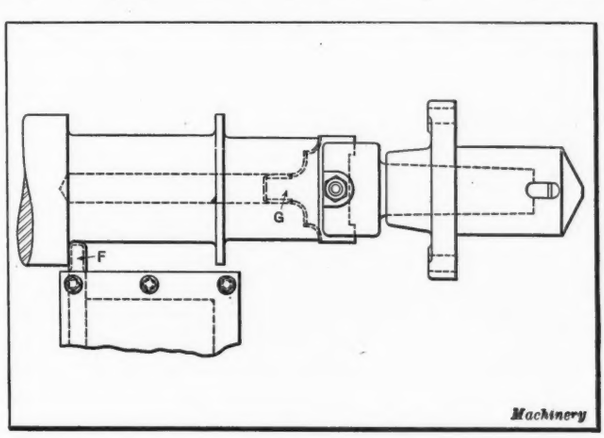


Fig. 15. Finish-turning the Back of the Pin with a Cross-slide Tool and finish-counterboring with a Turret Tool

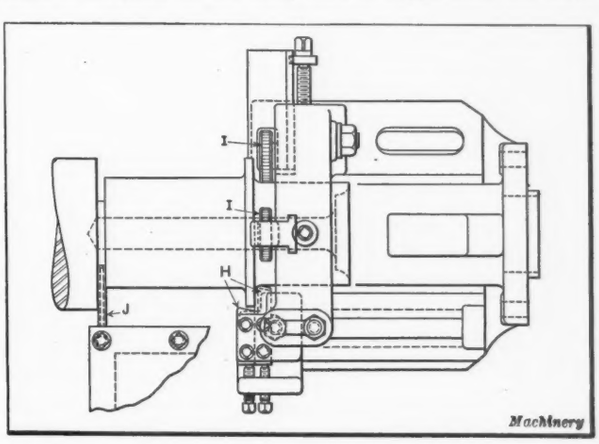


Fig. 16. Finish-turning Two Diameters with a Box-tool mounted on the Turret and cutting off with a Cross-slide Tool

jaw chuck, the arrangement being shown in Figs. 17 and 20. It will be seen that the chuck jaws grip the outside diameter of hub *A* and are simply depended upon to hold the work back in the fixture, the location and supporting of the casting being accomplished by means of adjustable clamping points *B*. These supporting points are steel plungers with a compression spring behind each of them, so that when the casting is pushed back into the fixture the spring plungers are brought firmly into contact with the work. Then after the chuck jaws have been tightened to hold the casting back in the desired position, a headless set-screw *C* is tightened against each plunger to lock it securely in place. One of the plungers, which is not shown in the illustration, bears against the side of a lug that is cast on the work, and in this manner constitutes a positive driver.

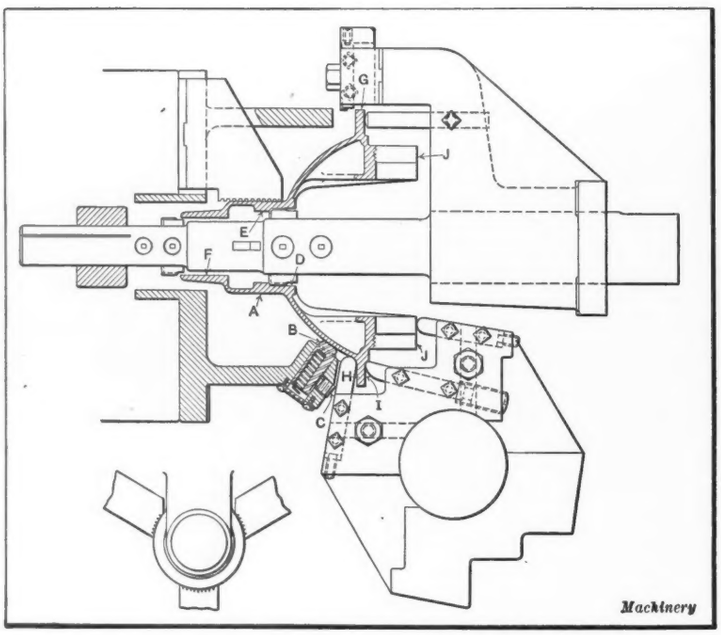


Fig. 17. Arrangement of Work-holding Fixture for machining Differential Gear Housings, and Combination Turret and Cross-slide Tools for simultaneously boring, turning, and facing

This job is completed at a single setting of the work, and the operations are performed as follows: (1) On the first station of the turret there is a combination boring and turning tool that bores diameters *D*, *E*, and *F* on the work and turns the outside diameter *G* of the flange. While this cut is being taken, tools carried by a turret toolpost at the front of the cross-slide provide for rough-facing surfaces *H* and *I* of the flange and faces *J* of the cross-bearings. (2) On the second face of the turret, a similar tool equipment is provided for finish-boring and finish-facing the surfaces that were roughed out by the preceding tools. (3) On the third face of the turret a collapsible tap is provided, as shown in Fig. 20, to provide for tapping sixteen U. S. form threads per inch in bore *E*. On the job the production time for completing each casting is ten minutes.

Turret Lathe Equipped for Machining Steel Artillery Hubs

In the United States Arsenal at Rock Island, Ill., Libby turret lathes are equipped as shown in Fig. 21 for use in machining steel artillery hubs of the form indicated by cross-sectional views in Figs. 18 and 19. A comparison of this job with the operations discussed in connection with the heading illustration and Figs. 2 to 4 will be of interest, because the work is of quite similar form in both cases, but the machines used at the St. Louis Malleable Castings Co.'s plant were equipped with special tools, while standard tools were adopted for use at the Rock Island Arsenal. An exception to the general plan of using standard tools at the arsenal was made in the case of boring-bars for operation in the hub, which are of special design. From Fig. 21, it will be apparent that a three-jaw chuck is employed to hold the work, the gripping power of this chuck being supplemented by three set-screws, that are depended upon to support the end pressure. After a casting has been set up on the machine, tools mounted on the cross-slide turret toolpost are brought into operation to take a preliminary cut over all the faces that have to be machined, in order to remove

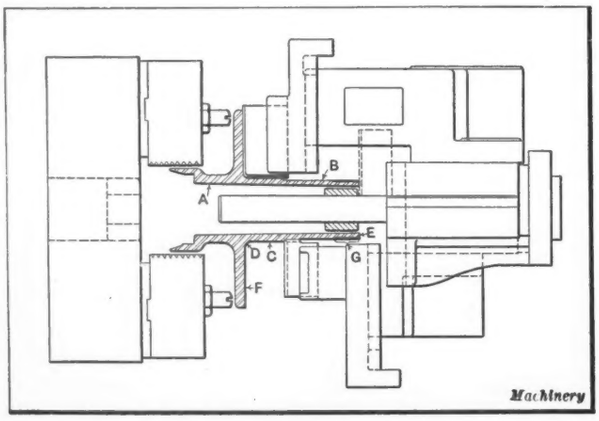


Fig. 18. Provision for chucking Work for First Sequence of Operations on Wagon Hubs. A Combination Turning and Facing Tool is shown in Operation

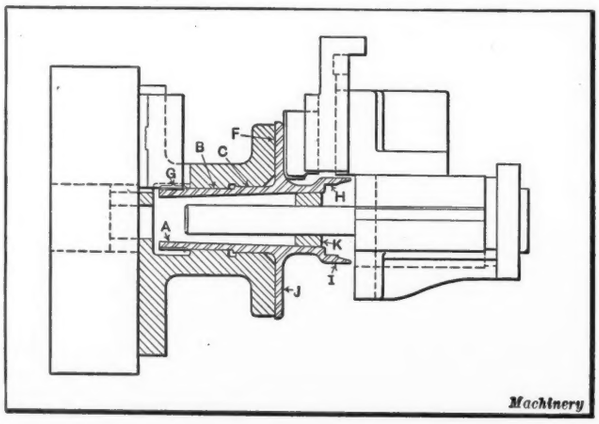


Fig. 19. Provision for holding the Work for performing the Second Sequence of Operations. A Piloted Facing Tool is shown in Operation

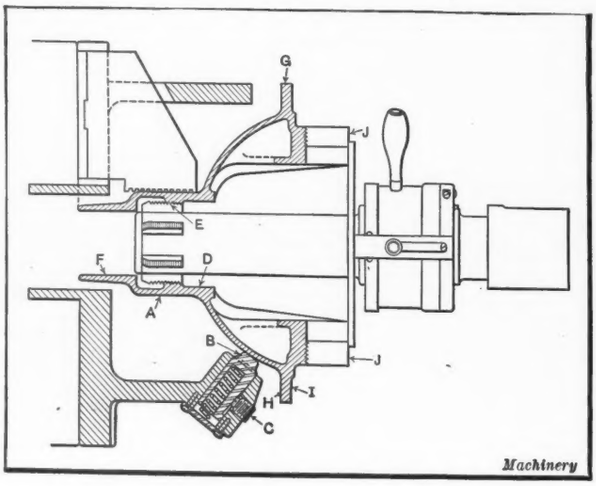


Fig. 20. Collapsible Tap for threading the Previously Bored Hole E in Differential Gear Housing

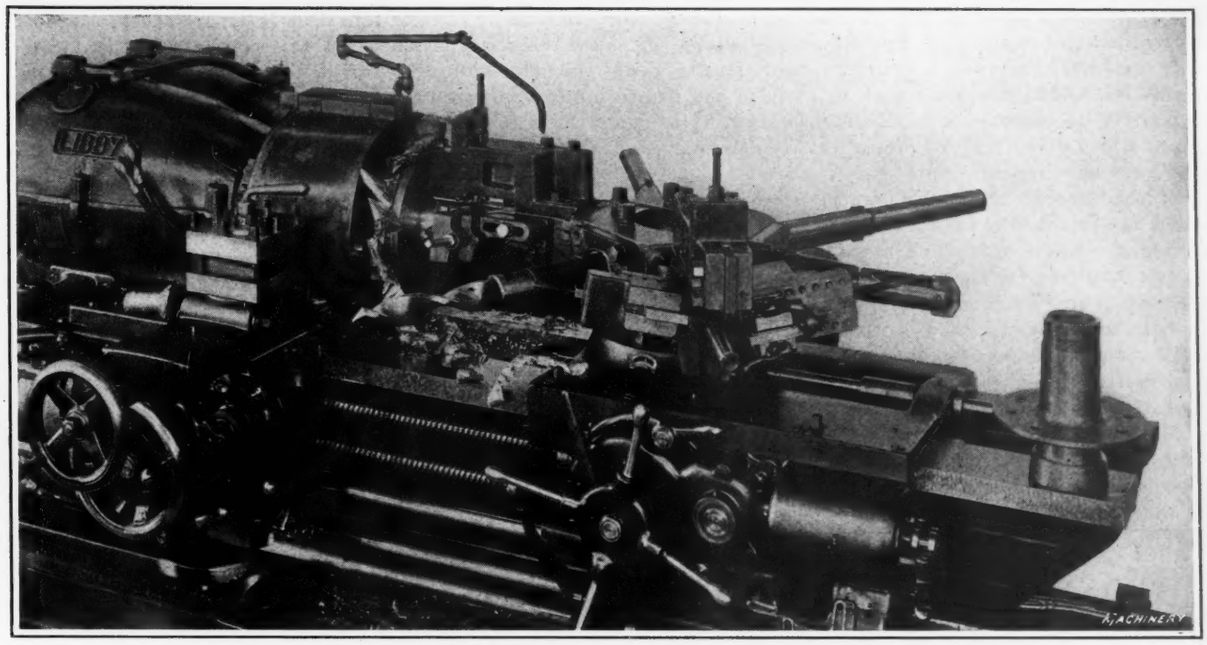


Fig. 21. Turret Lathe equipped with Standard Tools for machining Hubs of Military Wagons

scale and thus protect the regular production tools from damage. In addition to removing the hard oxide scale from those surfaces of the casting which are to be machined, the tools provided on the cross-slide have "stocked" off a majority of the excess metal, so that subsequent turning operations can be performed under more favorable conditions.

After this preliminary work has been accomplished, the method of procedure in handling the regular operations is as follows: (1) On the first face of the turret there is a Celfor flat twist drill of the type made by the Clark Equipment Co., Buchanan, Mich., which drills out bore *A*, Fig. 18, from solid metal. (2) The next face of the turret is equipped with a special stub-end boring-bar which takes an intermediate cut in the hole. (3) On the third turret face there is a Davis piloted boring-bar which takes a semi-finishing cut. (4) A similar tool on the fourth face of the turret finish-bores hole *A* in the hub. (5) Before bringing the tool on the fifth face of the turret into operation, a bushing is inserted in the finish-bored hole in the work, this bushing being a sliding fit in the work and a running fit on the pilot of the combination turning and facing tool which is next brought into operation. This tool is of standard design, except for the over-arm, and it is depended upon to turn diameters *B* and *C*, to form radius *D*, and to face surfaces *E* and *F*. (6) On the sixth face of the turret a tool of similar design to the one just used provides for finish-turning and facing surfaces *B*, *C*, *D*, *E*, and *F*. (7) Mounted in the turret toolpost on the cross-slide there is a single-point thread-chasing tool which is next brought into operation to provide for chasing a thread as indicated at *G*. For the performance of this sequence of operations the production time is seventy-two minutes.

Operations Performed at Second Setting of Artillery Hubs

After completing the sequence of operations which has just been described, the partially machined artillery hubs are reset on a turret lathe equipped with a special pot fixture of the form illustrated in Fig. 19. Reference to this illustra-

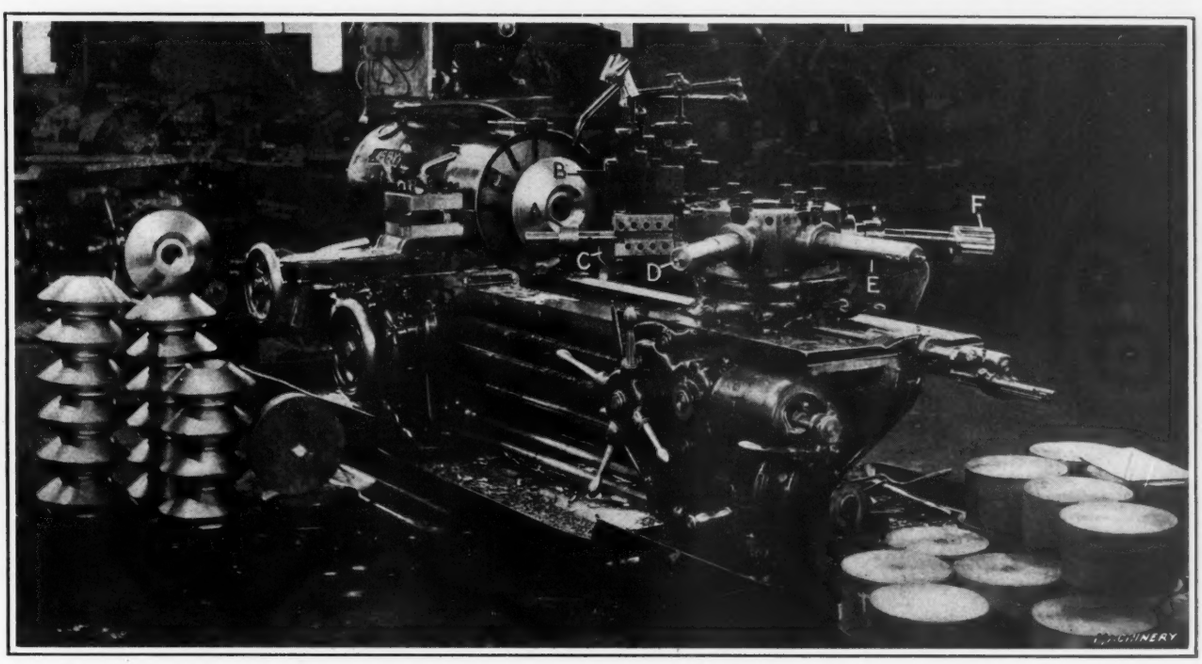


Fig. 22. Turret Lathe set up for performing First Sequence of Operations on Bevel Gear Blanks

tion will make it apparent that surfaces *F*, *C*, and *B*, previously machined on the work, are utilized as locating points, while thread *G* is screwed into the threaded chuck jaws to provide for holding the work back in place in the fixture. On this job the sequence of machining operations to be performed is as follows: (1) To protect the regular production tools from unnecessarily rapid wear, a so-called "stocking" cut is taken over all the surfaces which are to be machined. (2) On the first face of the turret there is a stepped boring-bar which provides for taking a preliminary cut to bring hole *A* to the required tapered form, and at the back of this tool there is also a formed counterbore for taking a preliminary cut in the work at *H*. (3) On the next station of the turret a tapered reamer provides for removing the excess metal that is left by the stepped boring-bar. (4) The next turret face is furnished with a reamer of similar design, which completes the taper-cutting operation. (5) On the fourth turret face a combination turning and facing tool of the type shown in Fig. 19 is provided for use in turning twist drill. While this drill is in operation, a wide-faced shaving tool mounted on the same face of the turret is brought into use to provide for taking a stocking cut on the face of the gear blank, and a second tool takes a preliminary cut in the counterbore, to quickly remove excess metal. (2) On the second face of the turret there is a tool-head with a pilot *A* to enter the drilled hole in the work. This head is provided with a tool *B* to take a finishing cut over the face of the gear blank and a tool *C* for finishing the counterbore. (3) The third face of the turret is provided with a boring-bar *D* which takes an intermediate cut in the hole. (4) Bar *E* mounted on the next face takes a semi-finishing cut in the bore. (5) On the fifth face of the turret there is a reamer *F* for finishing the hole in the gear blank. Carried by the turret toolpost on the cross-slide there is a cut-off tool that runs down the back of the gear blank and produces a clearance for another tool in this turret toolpost that is used for forming the back angle of the gear blank. The time taken for this sequence of operations is fifty-four minutes.

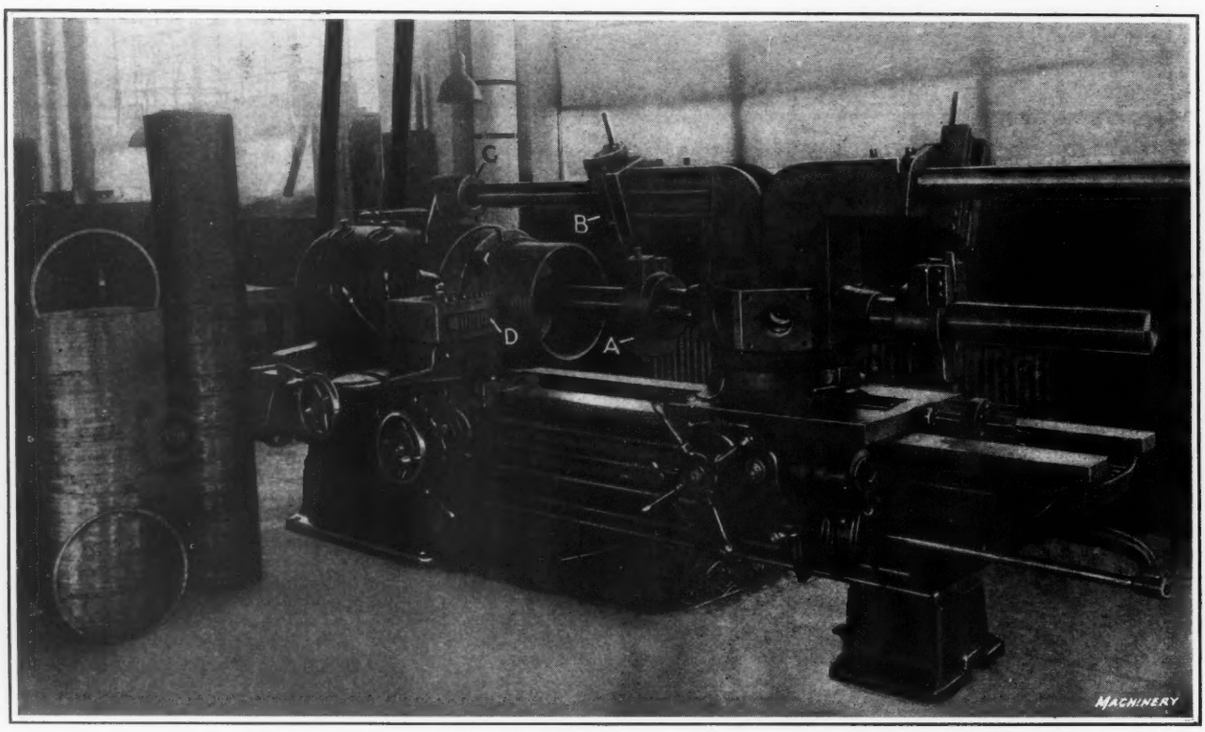


Fig. 23. Turret Lathe equipped for turning, boring, and cutting off Piston Rings from a Pot Casting. Provision can be made for machining either Concentric or Eccentric Rings

diameter *I* and facing flange *J*. It will be evident that this tool is of the piloted type, and a bushing *K* is introduced into the finished bore of the work before this tool comes into operation, in order to assist in maintaining perfectly accurate alignment. On this job the production time is seventy minutes for performing the sequence of operations.

Turning Bevel Gear Blanks

An ideal turret lathe job, that is to say, one on which the turret lathe can show the most advantageous results, is one where there is a sequence of boring, reaming, tapping, turning, facing, and similar operations to be performed. Several good examples have already been presented. Another case where the turret lathe shows its possibilities to good advantage is in the machining of bevel gear blanks. Fig. 22 shows a Libby lathe used at the R. D. Nuttall Co.'s plant in Pittsburg, Pa., for performing the first of two series of operations that are required to bring these blanks to the desired form. The material to be machined is steel billets. At the first setting of the work, the blank is held in a three-jaw chuck and the sequence of operations is as follows: (1) Drill out the central bore from the solid metal with a 3-inch Celfor

For the second setting of the work, the gear blank is held by a three-jaw chuck furnished with special soft V-shaped jaws that fit over the face and back angles of the work. In preparing for the performance of this sequence of operations, a bushing is first entered into the bore of the gear blank to receive pilots on the tools used for performing the required operations, which are as follows: (1) Conforming with the usual practice, a preliminary or so-called "stocking" cut is taken over the surfaces to be machined with a tool mounted in the turret toolpost on the carriage, to provide for removing the oxide scale. (2) On the first turret face there is a piloted combination turning and facing tool that turns and faces the hub of the gear blank. (3) A tool of the same type, mounted on the next face of the turret, performs a finishing operation on the same surfaces. For the performance of this second sequence of operations, the time required for machining is sixteen minutes.

Turning Piston Rings on the Turret Lathe

The Wasson Piston Ring Co., of New Brunswick, N. J., uses a method of machining piston rings on the turret lathe, which gives very satisfactory results. This equipment was

designed and developed by the International Machine Tool Co. The rings are machined from so-called "pot" castings, which are molded from patterns that form a V-shaped lug at one end of each pot, to furnish a convenient and secure means of holding the pot in place on the lathe chuck. Fig. 23 shows a Libby turret lathe set up for this job. The sequence of operations performed on these parts is as follows: (1) Remove oxide scale from the casting with a stellite tool supported in the turret toolpost on the cross-slide. (2) Mounted on the first face of the turret there is a combination boring and turning tool, with cutters to provide for taking a straddle cut on the wall of the pot, that is to say, for boring the inside diameter and turning the outside diameter. Reference to Fig. 23 will make it apparent that each of these tools is piloted, the pilot on the boring tool *A* entering a bushing in the chuck, while the pilot on the turning tool *B* enters a bushing *C* mounted at the top of the lathe headstock. (3) After taking the roughing cut with these tools, the turret is indexed 180 degrees to provide for bringing into operation a similar pair of tools that is mounted on the opposite side of the turret. These tools are piloted in the same manner as those used for roughing, but the bits are arranged to take a finishing cut over the inside and outside surfaces that have just been rough-bored and rough-turned. (4) Carried by the toolpost on the cross-slide there is a stepped, multiple cutting-off tool *D* which provides for cutting up the turned and bored pot casting into individual piston rings, the successive tool bits being arranged so that they cut off the rings in progressive order from right to left. This cutting-off tool is provided with spacers between the tool bits, so that any required spacing may be obtained to conform with the width of the piston rings. With this equipment a pot casting can be machined and cut up into twelve piston rings in a period of three minutes per ring; and provision can be made for producing either concentric or eccentric rings by this method.

* * *

UNUSUAL DRILLING IN CHROME-NICKEL STEEL

Demonstrations made during the convention of the American Railroad Association held recently at Atlantic City showed that hard and tough alloy steels can be economically drilled on a real production basis. In these demonstrations various sizes of holes were drilled in pieces of open-hearth chrome-nickel steel 3 inches thick, a penetration rate of 20 inches per minute being obtained with 1-, 1⅛- and 1¼-inch drills. Twenty inches per minute is equivalent to 1 inch every 3 seconds, which is considered a remarkable rate of penetration in drilling steel of this nature. The results of the tests are shown in tabular form and were obtained by using high-speed drills, made by the Whitman & Barnes Mfg. Co., Akron, Ohio, on an American 6-foot radial drilling machine. The composition of the material drilled was: Carbon, 0.50 per cent; chromium, 0.90 per cent; nickel, 1.00 per cent; and manganese, 0.75 per cent. These demonstrations were made at speeds and feeds which can be duplicated under shop conditions, and indicate how production can be economically increased.

DATA OF RESULTS OBTAINED IN DRILLING CHROME-NICKEL STEEL

Size of Drill, Inches	R.P.M. of Drill	Feed per Rev., Inch	Drilling Rate per Min., Inches	Drilling Time, Seconds	Average No. of Holes Drilled per Grinding
1	500	0.040	20	9	32
1⅛	500	0.040	20	9	24
1¼	500	0.040	20	9	27
1½	500	0.029	14½	12½	29
2	206	0.040	8¼	22	27
2½	206	0.022	4½	40	12

Machinery

THE METRIC SYSTEM IN SCANDINAVIA

Through the Publicity Service of the American Institute of Weights and Measures, 115 Broadway, New York City, we have received the following communication signed by J. Christian Barth of the firm of Carl G. Barth & Son, Philadelphia, Pa., which refers to the conditions in regard to systems of measurements in Sweden and Norway. Mr. Barth writes:

"I recently returned to the United States after three and one half years' visit to Sweden and Norway. I first came in contact with the metric system in my work in 1916-1917 in Finspong, Sweden. It was necessary for me to make some drawings of equipment, and not being acquainted with the metric system, I was told to use the English system which I was accustomed to, writing plainly on the drawing that it was drawn to the English system. I later discovered that the Swedish metal industries use no less than four systems of measurement; in Norway, there are three systems.

"In the work of arranging store-rooms, I had great difficulty with bolts, nuts, etc. Piping, iron bars, and shafting, etc., are always stated in English measure; bolts, nuts, and similar articles in both the English and metric measures. Quite frequently we received these in metric sizes when they were ordered in English sizes, and the reverse. I recall one instance of rivets, where the diameter comes in inches and the length in millimeters.

"There is a similar confusion with the measures of weight; though nominally there is only the metric system in use, the old Norwegian terms are still largely used. Thus we still buy a pound, though it weighs ½ kilogram. From my experiences in Norway and Sweden, I am much averse to changing the system in use in this country, because of the confusion due to the conglomeration of terms that creep into use, and the length of time it takes to get the old system out and the new in. In Norway, I frequently met with the assertion that it was only the passing generation who held to the older systems, but my observations were to the contrary.

"On the whole, I consider that the burden of changing in our country would be too great to warrant changing. We have our goods scattered over the world which need repairs for a long time. The confusion would certainly last for generations to come."

* * *

MACHINERY IMPORTS INTO SOUTH CHINA

The port of Hongkong is the main port of entry for machinery imports into South China, and the figures given in a report by Consul General George E. Anderson of Hongkong are therefore of interest as indicating the possible demand for machine tools and other classes of machinery in this part of the world. During 1919, Hongkong imported $278,000 worth of machine tools, of which about two-thirds came from Great Britain and one-third from the United States. The total imports of all classes of machinery amounted to $2,550,000, and included steam engines and boilers, internal combustion engines, pumps, electrical machinery, and textile machinery. In steam engines and internal combustion engines, the United States led, supplying about 75 per cent of the total imports valued at over $500,000. The same proportion held true in regard to electrical machinery, of which about $500,000 worth was also imported. Great Britain furnished practically all of the remainder both in the engine and the electrical machinery field. In pumping machinery and general machinery for use on shipboard, Great Britain furnished over 75 per cent.

There is some uncertainty as to the future in the business circles of China; the political conditions in South China are especially uncertain, and the imports of machinery in 1919 were considerably less than in 1918. It is evident, however, that there is a considerable market for machinery of all kinds there, and the United States ought to secure its share in the machine tool lines as well as in the other lines.

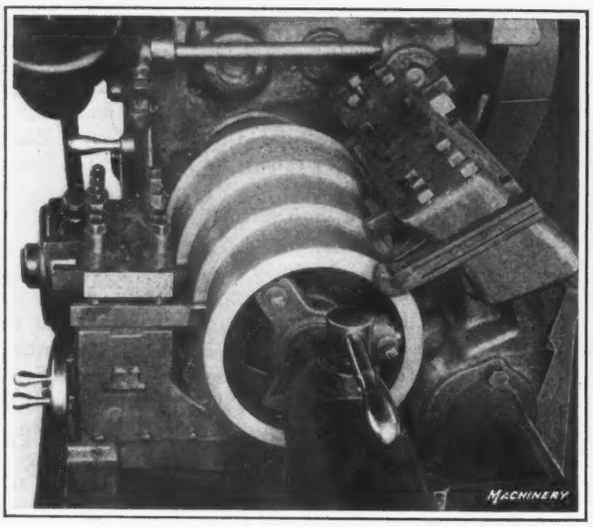


Fig. 1. Machine provided with Tooling used in Finishing Operations on a Three-step Cone Pulley

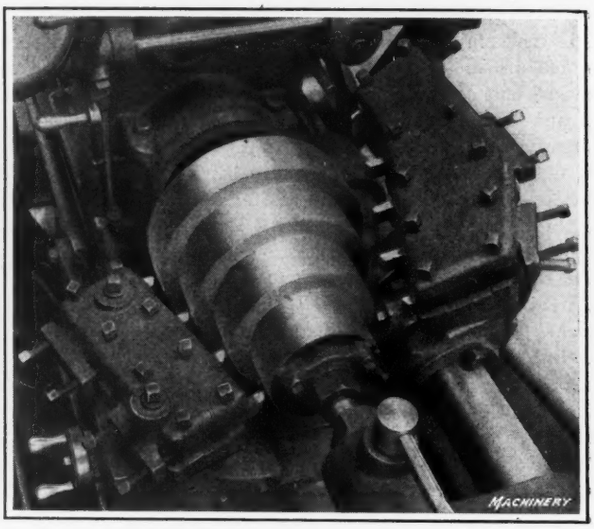


Fig. 2. Set-up of Machine employed in Roughing Operations on a Four-step Cone Pulley

Machining Cone Pulleys

Tooling Equipment and Methods Employed in the Quantity Production of Three- and Four-step Cone Pulleys

By RALPH E. FLANDERS, Manager, Jones & Lamson Machine Co., Springfield, Vt.

THE machining of cone pulleys on an engine lathe is necessarily a slow method due to the large number of cuts which must be taken one at a time. Thus, it is obvious that if large quantities of pulleys are produced on machines of this type, the rate of production will be comparatively low. The purpose of this article is to describe a way in which the production rate can be materially increased for work of the kind mentioned. The machines employed in the method to be described are Fay automatic lathes provided with a sufficient number of tools so that the turning or facing cuts on the various surfaces to be machined can be taken simultaneously. This is made possible by the construction of the lathe, which provides multiple tool-holders for both turning and facing, operated by independent cam movements. In this way the machining of all the surfaces can be accomplished in the time required for machining the longest one. These machines are automatic in all their movements, and are stopped automatically by a brake at the end of an operation.

Two machines are used in the operations on a pulley, one being provided with equipment for taking the roughing cuts, while the other takes the finishing cuts. These two machines are placed adjacent to each other, and are so timed that the work removed from the roughing machine is at once placed on the finishing machine, after which a new piece of work is put in the roughing machine. The work is mounted on arbors which are placed between the centers of the machines during the operations. Three arbors are provided so that one can be used for changing the work while the other two are in action. This eliminates having the machine idle while a finished pulley on an arbor is being replaced by a rough one.

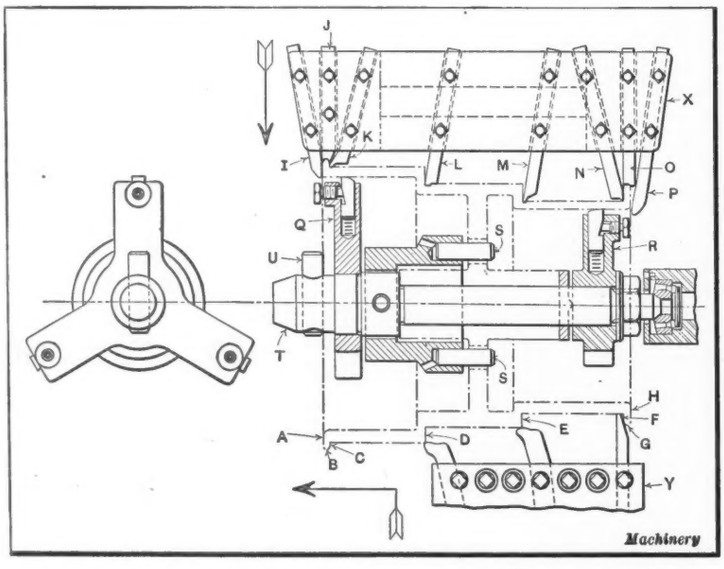


Fig. 3. Tool Lay-out used in Turning and Facing Operations on a Cone Pulley

Machining a Three-step Cone Pulley

The lay-out of the tooling equipment provided for rough-turning and rough-facing a three-step cone pulley is illustrated in Fig. 3, in which the outline of the work is shown by dot-and-dash lines. The work is mounted on arbor *T* by means of the reamed hole through the pulley hub, and is located longitudinally on the arbor by the hub faces. The hole and hub faces of the pulley are finished in a preceding operation. The rims of the two outer steps are adequately supported on the inside by the three-armed spiders *Q* and *R*. The arms of these spiders are each provided with a pin that is forced against the work by an expansion coil spring, placed in the same hole as the pin. When the pins are in contact with the pulley rim, they are clamped in this position by means of screws bearing on plugs machined to suit a taper surface on each pin. The arbor is rotated by a driving pin on the faceplate of the machine, which comes in contact with pin *U* on the arbor, the pulley, in turn, being driven by pins *S* which extend through holes in a rib on the pulley beneath the middle step, as can be clearly seen.

In operation, the arm on which the rear tool-holder *X* is mounted, swings forward, thus causing the tool-holder and the tools to rock toward the work in the direction indicated by the arrow shown adjacent to this tool-holder. When this occurs, surface *A* is faced by tool *I*; surface *B* is

rounded by tool *J*; surfaces *C*, *D*, *E*, and *F* are faced by tools *K*, *L*, *M*, and *N*; surface *G* is rounded by tool *O*; and surface *H* is faced by tool *P*. At the same time that these tools are being operated, the front carriage *Y* is first moved toward the work until the tools mounted on the carriage are taking the proper depth of cut, and then longitudinally forward, during which movement each of the three steps on the pulley are straight-turned by one of the three tools mounted on the carriage. The direction of the two carriage movements is indicated by the arrow in the lower part of the illustration. It is evident that the pulley is machined in the time necessary for one of the tools on the carriage to take a complete cut on one of the steps. Fig. 1 shows the machine used for finish-turning and finish-facing the various surfaces, during which operation a curved crown is produced on each of the three steps. A former beneath the front carriage gives the tools the required movement for accomplishing the crowning. The actual production on this work is six pulleys per hour, roughed and finished complete, one man running two machines.

Equipment for Finishing a Four-step Cone Pulley

A machine provided with the tools used in taking the roughing cuts on a four-step cone pulley is illustrated in

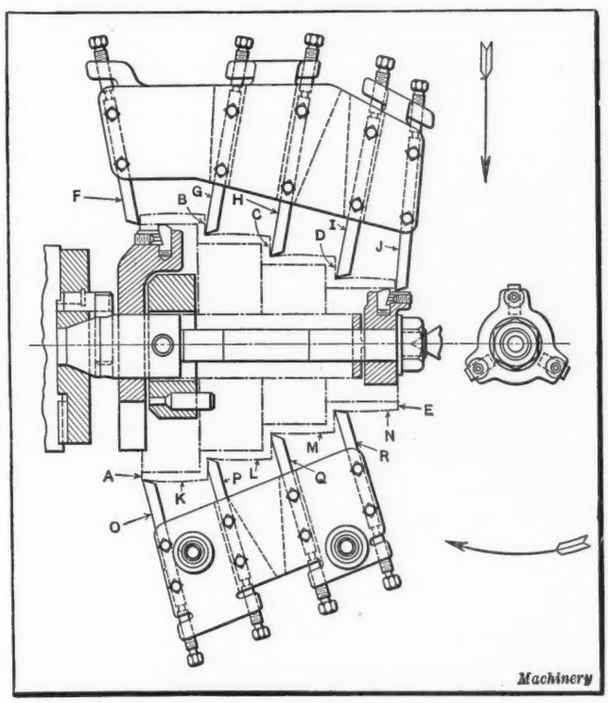


Fig. 4. Tooling Equipment furnished for the Final Operation on the Four-step Cone Pulley

Fig. 2, the operation having been completed when the photograph was taken. In this operation the several steps are straight-turned. The equipment employed in the finishing operation is very similar, as shown in Fig. 4. The arbor on which the work is mounted is of practically the same construction as the one used in connection with the machining of the three-step pulley previously considered. In this operation, when the rear tool-holder is rocked toward the work, surfaces *A*, *B*, *C*, *D*, and *E* are faced by tools *F*, *G*, *H*, *I*, and *J*, respectively. At the same time that these cuts are being taken, the front carriage is moved in the direction indicated by the arrow near the bottom of the illustration, during which movement surfaces *K*, *L*, *M*, and *N* are crowned by tools *O*, *P*, *Q*, and *R*, respectively. The curved movement of the tools in this case also is obtained by means of a former placed beneath the carriage. As in the preceding example, this operation is completed in the time required for one of the tools on the carriage to be fed longitudinally a distance equal to the width of one step.

MOVING PICTURE SHOWING BELT MANUFACTURE

Few men realize the great number of operations and the time and labor necessary to produce a finished belt from a raw hide. From six to eight months time is required for the purpose, the greater portion of this time being consumed in cleaning the hide preparatory to its tanning and in the tanning process. With a view to educating the mechanical public along these lines, the Charles A. Schieren Co., New York City, produced a moving picture of all the stages of the belt-making industry from the time that the raw hide arrives at the company's tannery at Bristol, Tenn., until the finished belts are shipped from their New York factory ready for service. This interesting moving picture, which consists of 3800 feet of film, was shown for the first time at the Machinery Club, New York City, on June 29.

The portion of the film devoted to the preparation of the hides for the tanning process shows the methods and machines used in removing the flesh and the hair and in soaking the hides before this can be accomplished. The picture then shows the method of extracting the tannic acid used in tanning. This is extracted from chestnut oak bark that is dried and ground, after which the tannic acid is obtained by a leaching process and pumped to storage tanks. For the purpose of tanning, the hides are placed in a rocker for eight days, and then in layers in vats for 120 days, the rocker and vats containing a tannic acid solution. Ground bark is also placed between the layers of hides in the vats. During the time that the hides are in the vats, they must be frequently removed and replaced for the purpose of putting a fresh solution in the vats and fresh bark between the layers. After the tanning is completed, a number of operations, including stretching and polishing, are performed, and then the hides are ready for the manufacture of belting.

Among the various things shown in the part of the film taken at the New York plant, are the methods used in cleaning the hides from all dirt and grease that may have accumulated during shipment, in sorting them according to weight and grade, in cutting them into proper belt widths, in cementing the various belt sections together, and in waterproofing the belts when completed. The process of cementing two-, three-, and four-ply belts is also shown, as is the manufacture of round belting and leather link belts. The clear, concise captions and the fact that all machines are shown in actual operation, permit everything that is seen in the picture to be readily understood. The educational value of such a film cannot be overestimated and it will be made available for exhibition before engineering societies, schools, and colleges, and in industrial plants upon application to the Charles A. Schieren Co.

* * *

AMERICAN MACHINERY TRADE IN INDIA

In his report on the conditions and prospects of British trade in India, Thomas M. Ainscough, British Trade Commissioner, states that competition from the United States is becoming particularly keen in electrical, mining, steelworks plant, oil-crushing, and refining machinery, machine tools, and miscellaneous engineering supplies for industrial purposes. Before the war British makers had such a hold on the trade, largely because purchases were usually made in London by the managing agents of Indian industrial concerns and because British engineering practice and standards were preferred, that foreign competition made little headway. During the past four years orders have had to be placed in the United States for immediate requirements, and it is likely that the American connections, having once been made, will be retained. So far, very few American manufacturers have opened offices in India, but their representatives are very active. Previous to the war, the United State's share of machinery imports into India was only 3 per cent; at the present time it is 28 per cent of the total.

Training Electric Welders



Methods Used by the General Electric Company, Schenectady, N. Y., in the Training of Operators of Electric Welding Equipment

THE arc welding school maintained at the Schenectady works of the General Electric Co. originated during the drive to train men in industrial pursuits demanded by the requirements of the war. The specific purpose for which the school was instituted was to train commercial welders for the Emergency Fleet Corporation. After the exigencies of the industrial program of that period had passed, it was deemed advisable to continue the school as a permanent institution. The school was the first of its kind established in the country, and it attained a reputation for turning out men of high proficiency in the art of electric arc welding. It is at present operated on practically the same basis as when it was first opened.

The training of men as electric welders is just as essential in obtaining satisfactory results as the training in any other line of trade. The General Electric Co.'s school is primarily intended for the training of operators of the welding equipment that the company sells to its customers. The customer sends his own employes to the school to receive the training. Instruction is furnished without any charge to the customer, other than the transportation and living expenses of his employes and prospective welders. While, therefore, the men trained are usually in the employ of users of the General Electric Co.'s equipment, many also receive instruction regardless of connection with any industrial concern.

Scope of the Training

The object of the school is to train men in the manipulation of the arc, and to instruct them in regard to how the equipment should be handled, as well as the proper current values for use with different sizes of electrodes and work. The theoretical explanation of the causes of stresses produced in heated metals and the chemical action of various metals in the weld is not a part of the instruction. A lecture is given once a week by various members of the engineering and laboratory forces of the company upon the fundamentals of welding and metallurgy. These lectures are attended by the students in a body, and an attempt is made to answer all questions which the students ask. All equipment is furnished free of charge either to the student or to his employer. The capacity of the school is sufficient to take care of about twenty men at a time, there being a constant turnover in the personnel of the student body. There is no set time for the length of the course, because the time required may vary greatly for different students. In general, it has been noted that younger men can become proficient welders more readily, and that men above forty years of age do not generally become good and speedy welders. The average length of time required in the instruction, in order to produce a finished welder, is from forty to fifty days, although the entire training is often completed in considerably less time. It is not necessary for the student to receive the full course of instruction. He may qualify for such welding work as making repairs in castings, carbon arc welding, or recovering broken taps and drills from castings, the training for which may be acquired in a very short time.

Primary Instructions and Duties

The student, upon entering the school, is assigned to a booth such as shown in the heading illustration, and the various courses, of which there are six, are fully explained by the instructor in charge. An attempt is then made by the instructor to ascertain just what courses the various students are desirous of learning, or the special line of work which would be of the greatest advantage to the particular concern from which the new students have been sent. After this has been determined, the basic principles of arc welding are taught. These principles concern the length of the arc; the proper position in which to hold the electrode; the method of breaking the electrode from the work should it become frozen to it; the current values for electrodes of various temperatures; and the combination of current value and electrode size for various classes of work. These elementary instructions are then followed by the first four simple exercises in depositing metal and controlling the rate of deposition.

Fig. 4 shows of what the various exercises included in the course consist. For example, the first four elementary exercises involve depositing 6 inches of metal on 6 inches of plate; welding parallel rows $\frac{3}{8}$ inch wide the entire length of the plate, leaving a $\frac{1}{2}$-inch space between each row; laying a second layer of metal on the previously deposited parallel rows, maintaining the same width of spacing; and finally, filling in the $\frac{1}{2}$-inch spaces with one layer of metal. The fifth, sixth, seventh, and eighth exercises consist of depositing metal in the same manner as the first four exercises but with the plate set at an angle of 45 degrees, the operator making the weld from the bottom up. The next four exercises are performed in like manner with the plate set in a vertical plane, the metal being deposited from the bottom upward. By this time the welder has acquired the

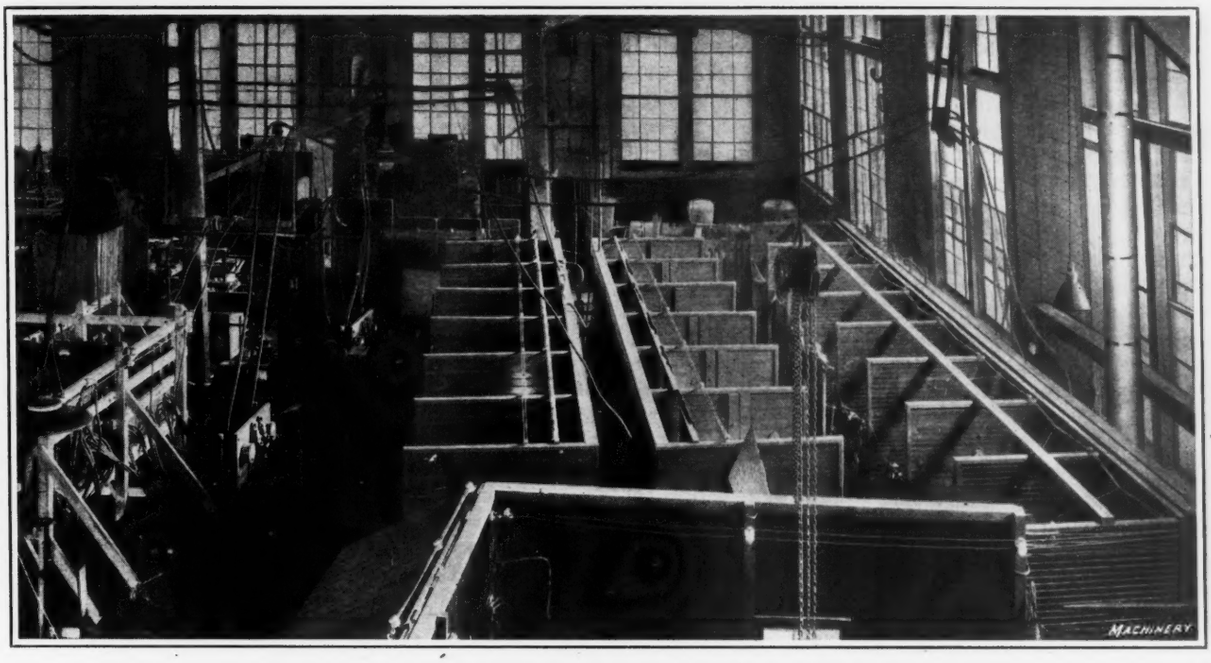


Fig. 1. View of General Electric Co.'s Welding School, showing Booths for Operators

ability to manipulate the arc and to judge the rate of depositing the metal with a known amount of current. Before the student has progressed too far, he is given a week's training on practical work under the supervision of the welding foreman, after which he is started on any special course of study that may have been decided upon. If no provision for the student's further advancement has been made, the right is reserved by the instructors to teach the student the course that seems of most value to the company that will later make use of his services.

Procedure after the Student has Acquired the Fundamentals of the Course

As soon as the students have reached the point where they are capable of performing certain production jobs they are put on this class of work for a time, until they have demonstrated that they have acquired the necessary degree of skill. This method, which enables the student to actually produce, is a factor in reducing the maintenance cost of the school. The men are then shifted back to the exercises for more advanced instruction, and this procedure is continued throughout the course. The complete instruction program includes forty specific exercises. The first actual welding, as shown in Fig. 4, occurs in Exercise 13, in which the student is required to make a butt-weld with two ⅛-inch plates in a horizontal position. Exercises 14 and 15 consist of butt-welding with the plates set at a 45-degree angle, and in a vertical position, respectively, the welding in both cases being performed from the bottom of the plates upward. Exercises 16, 17, and 18 consist of butt-welding two ¼-inch plates together at an angle of 90 degrees, in three positions—horizontally, at 45 degrees, and vertically, respectively. In the two latter cases the weld is made from the bottom upward.

Exercise 19 consists of making a horizontal weld in the corner of two ¼-inch plates arranged to form an inverted T.

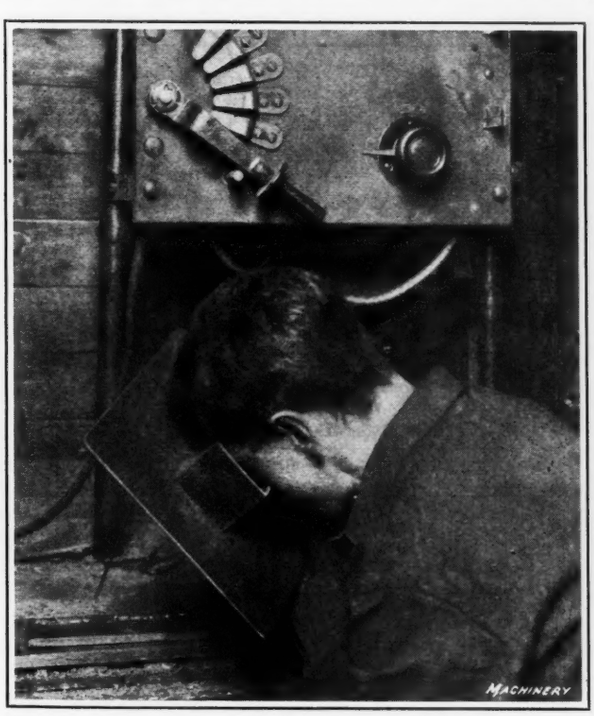


Fig. 2. Welder at Work depositing Metal

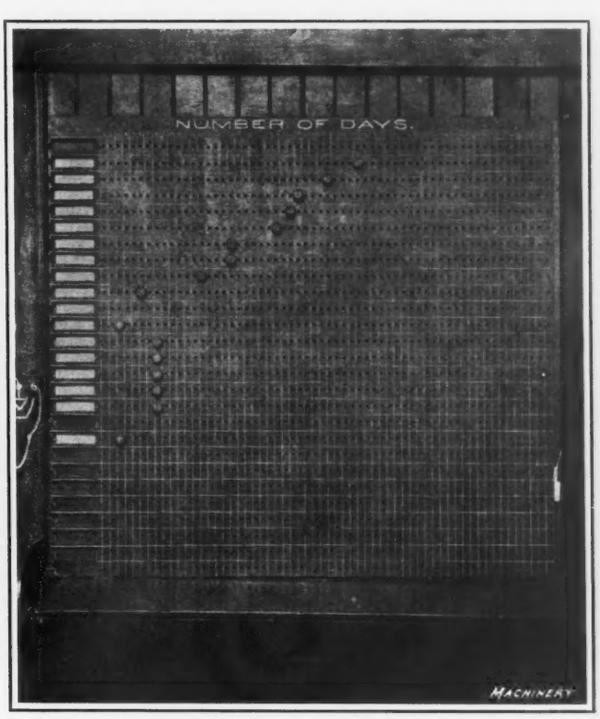


Fig. 3. Board for indicating Progress of Students

In Exercises 20 and 21, T-welds are made, as shown in the illustration, the work being tipped at a 45-degree angle in one case, and set in a vertical position in the other. The welder is required to deposit four layers of metal and to chip and brush the scale from each layer before adding the succeeding layers. The next four exercises are performed with the plate in a vertical plane, the weld being made in a horizontal direction. In the first of these—No. 22—parallel beadings are laid, spaced ½ inch apart; the next exercise consists of filling in the ½-inch spaces in the parallel rows just deposited; and the two following exercises consist of depositing row upon row of metal first from the bottom up and then from the top down. In Exercise 26 the plate is placed in a vertical plane, and a 3-inch diameter circle of beading, ¼ inch wide, is made in the face of a plate, and then circular beading is welded inside and outside alternately, until the plate is entirely covered. Exercises 27, 28, and 29 are lap-weld exercises performed with the plates first in a horizontal position, and then in a vertical position and an inverted vertical position, respectively. The last exercise calls for considerable skill on the part of the student, it being the first overhead work that he has been required to do.

of which is filled with a ¼-inch metallic electrode and the other with a carbon arc using a ½-inch diameter filling rod. This exercise is furnished so as to enable the student to make a comparison between the metallic and carbon arc for filling purposes. Exercise 38 consists of cutting steel with the use of the carbon arc. Exercise 39 consists of welding ⅞-inch holes in ⅝-inch plate, both in a vertical and in a horizontal position. The last exercise in the course, No. 40, requires the student to run ⅜-inch beads on cast iron and to make a satisfactory butt-weld.

Recording the Progress of the Student

As previously mentioned, the work is not limited to exercises, but practice is also given on various odds and ends of practical welding when the students have advanced sufficiently to warrant this. A blackboard is in use in the welding school by means of which the progress of the student is recorded, and from which the relative advance that he has made can be readily seen. This board is illustrated in Fig. 3. The first column of the board gives the name and other identification notations of the students. To the right of this column, spaces are provided for each working day. It is not

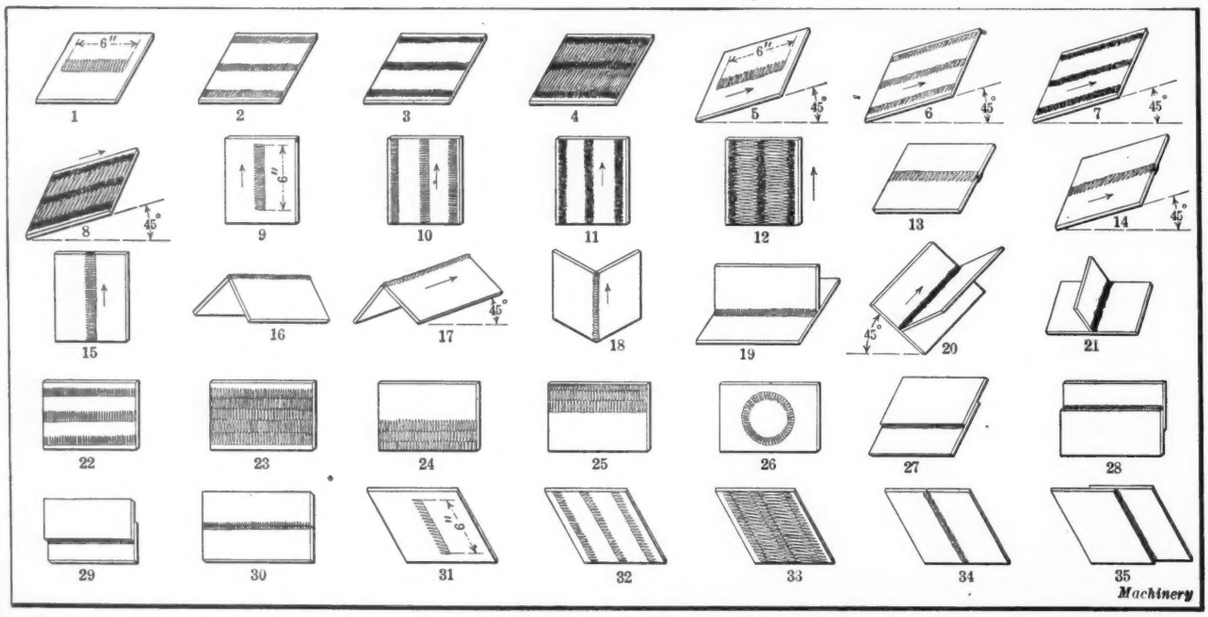


Fig. 4. Diagrammatical Representation of the First Thirty-five Exercises that the Student is required to master in the Course of his Instruction

The next exercise in order, No. 30, is that of butt-welding two plates in a vertical position, making a horizontal joint. The student is now required to gain control of the electrode for overhead work, and the remaining exercises illustrated in Fig. 4 are overhead exercises. Exercise 31 is that of depositing 6 inches of metal on 6 inches of plate, the work being placed in a horizontal plane. Exercise 32 consists of making parallel rows of beading, spaced ½ inch apart. In Exercise 33 this ½-inch space between the parallel rows just deposited is filled in. An overhead butt-weld with two ¼-inch plates is required in Exercise 34, while Exercise 35 consists of making an overhead lap-weld with ⅝-inch plates.

The five remaining exercises in the course are not shown, but they are as follows: Exercise 36 requires two men to perform a butt-weld on ⅝-inch plates which have not been beveled for receiving the metal. Both men are required to work together on each side of the work. This is a condition which they will surely encounter in their practical experience, and the exercise enables each man to become accustomed to the presence of another man on the job, and also to so regulate his rate of depositing the metal, that the amount deposited and the heat produced on each side of the joint will be balanced. The next step, Exercise 37, involves the making of two pens 3 inches square by ¾ inch high, one

presumed in any case that more than sixty days will be required to train the student completely, and therefore spaces for sixty days are provided on the board. As the student completes one lesson, a wooden plug bearing the number of that exercise is inserted in a hole in the board under the day on which he has completed the lesson. A number of these plugs are shown in the illustration, and the plugs travel from left to right on the board as the student advances. By this means, the instructor is enabled to tell at a glance just which of the men are the most proficient and also which may need special attention.

Selective Courses of Training

As previously stated, there are six courses which may be pursued. One of these consists of making repairs on steel castings. It is especially recommended to those students who come from foundries and machine shops where a knowledge of the manner of filling blow-holes, and repairing defective and worn parts and broken castings is necessary. The students are also made acquainted with the proper allowances to make for contraction and expansion and how to prevent depositing hard and unmachinable welds. The course on repairing cast iron has met with marked success, and although the welding of cast iron is not looked upon with

favor by some, yet to make the instruction complete, a course in this branch of the art is included.

The welding of steel plates and tanks offers the most complete training, and is especially recommended to the all-around welder. In this course the student is taught flat, vertical, horizontal, and overhead welding. He is also taught the proper heat value to use to correspond with the size of electrode, thickness of plates, and angle of work. In the course on welding tanks, the student becomes familiar with the proper precautions to take in preventing warping of the sheets, and the relative amount of metal to deposit to obtain the required strength.

There is a course provided in recovering broken taps and drills from castings. Among the various requirements of this course, the student is required to remove a number of taps and drills in an allotted time. The course in welding high-speed steel to low-carbon steel is very difficult and requires close study, due to the difference in melting points of the two metals. The course is particularly useful from a tool-room point of view, and has been the means of saving considerable money due to the cost of high-speed steel and the saving that can be realized by welding low-carbon shanks to high-speed tools.

The course in carbon arc welding and cutting is entirely different from that of metallic welding. With the carbon processes it is necessary to use the carbon arc as a preheater and to take the metal from a filling rod held in the left hand. With the use of the carbon arc, a much higher rate of depositing metal can be maintained owing to the higher values of current which may be used. For cutting large castings, the carbon arc is quite useful, as well as for salvaging scrap material.

The student is required to break up the weld that he has made on scrap material, and to examine it and determine where the weakness, if any, lies, as well as, if possible, what has been the cause for the failure. In such a case the aid of the instructor is often solicited, and any doubtful points are cleared up by him. In the course in making tanks, the welder is always present when they are put under pressure test, and may witness the results of his work. If the tank is a failure, the defective weld is examined, the cause for the deficiency is explained to him, and a method pointed out by which he may prevent a repetition of his mistake. Every exercise must be thoroughly mastered before the next is attempted. Just pointing out the cause of failure will not permit the student to proceed—he must demonstrate that he not only knows *how* to do the work, but *can* do it as well.

Fig. 1 shows a general view of the welding school, from which the locations of the individual booths may be seen, as well as an operating panel from which six welders are enabled to work simultaneously.

The progress of the student is carefully noted and a close check is kept on him from the time he enters the school until he leaves. A merit system is in use, and attendance and punctuality are closely recorded. A record of each student's rating is kept on file in the power and mining engineering department of the plant, and may be furnished to any employer who has sent a student for instruction, upon request. There are no certificates or diplomas presented to the welder on leaving the school, but a personal letter is given if desired, in which the particular kind of work for which the student is fitted is stated.

* * *

Previous to the war Belgium had fifty-five blast furnaces, of which seventeen were running on June 1 this year. The pre-war output per day was nearly 8000 tons of pig iron. The daily output of the fourteen furnaces now running is somewhat less than 3000 tons, indicating that while Belgium is rapidly resuming its industrial activity, there is yet much to be done. The main reason for not starting up all the blast furnaces is lack of fuel.

QUESTIONS FOR THE MACHINIST

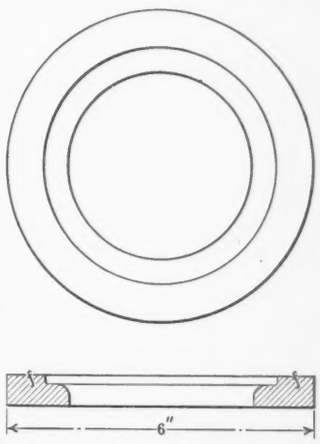
By A. W. FORBES

The accompanying list of questions was posted in the Forbes & Myers shop near where the operation referred to was being done. The sketch shows the operation, one surface only being faced, as marked. The writer believes that by a thorough study of questions of this kind, rapid advancement in machine work is possible.

FACING CORE FLANGES

A Few Facts You Should Know About this Operation

1. There are two operations—roughing and finishing.
2. The object of roughing is to remove the excess metal in the shortest amount of time.
3. What shape should the tool have to do this?
4. What material should be used for the tool? Stellite will cut faster, but will not stand shock as well as high-speed steel.
5. Should the tool be rigid or spring?
6. What is the highest speed at which the tool will stand up in this work? How does this speed compare with the speeds ordinarily recommended?
7. How long does it take to make the roughing cut at this speed, taking it all in one cut?
8. Can you take enough greater feed if two cuts are taken, so that the total time is less?
9. If you take the next speed slower, can you take enough larger chip so that the total time is less?
10. The object in finishing is accuracy and appearance.
11. Can you give the required degree of accuracy and finish on the same cut as the roughing, by using a slower speed, feed, or both? If so, will this take a longer or shorter time than to take a separate cut?



12. The finishing can be run faster than the roughing. Can you save enough time in this way to pay for shifting the belt?
13. What shape of tool is best for finishing this piece?
14. What material is best for this tool? High-speed steel will more readily give a good finish, but stellite will cut faster.
15. Can you save time and still get a good finish by using the same tool for roughing and finishing?
16. Are your answers to the above standard practice, or are special methods necessary due to the quality of iron, kind of lathe, or other special reasons?

After working at this job for a few days you should be able to answer all these questions and more. Most machinists cannot, but most machinists do not advance as rapidly as they might. This is one of the simplest jobs in the shop. With most of the jobs there is much more that you should know.

* * *

Whether there is any likelihood of a drop in the cost of building construction is a question of great interest to all manufacturers who contemplate building new shops or making additions to old ones. The Aberthaw Construction Co. of Boston expresses as its belief that there will be no immediate drop in the cost of building construction. There is no evidence that building materials will be reduced materially in price for some time to come; and while there is, at present a decline in building activities, it is not likely that this will directly influence the cost of construction.

Developing Initiative in Your Men

By WILLIAM A. ROCKENFIELD, General Manager, Baldwin Chain & Mfg. Co., Worcester, Mass.

DURING the writer's varied experience, it has often appeared that while systems may not be designed to deaden initiative, they very frequently have that effect. Initiative can be developed in a number of ways, and in many cases when there is an obvious lack of initiative, it is not altogether the person himself who is at fault. In order to develop initiative, the individual must be placed in a position where he is able to learn and understand all the interrelated factors which are known by the general term "the policy of the company." In many manufacturing plants men holding quite responsible positions often are not given an opportunity of learning exactly what the policy of the company is and hence their initiative is naturally curbed.

The capacity for initiative may be born in some men, but generally it is developed by a sense of responsibility that comes by increased duties. One way in which initiative may be developed in subordinates is to ask for the solutions of problems from the men themselves, rather than to provide the solution for them in every instance. When a man is seeking for the solution of a question of policy, instead of telling him the answer, ask him what he would do if the decision depended entirely upon himself. By your manner, try to impress upon him that you believe his judgment will be right and that he can solve the problem himself, and in nine cases out of ten he will do it. He is put in a position where he has to show what is in him—in other words, where he has to make good. The problem will be before him until he has found a solution, and generally the solution will be the right one.

Bringing Out Men's Latent Abilities

An executive should not take it upon himself to know all the details, or to embody within himself all the composite skill of the whole organization. As a matter of fact, an executive who undertakes to do this generally will accomplish less than the one who knows when the proper moment has come to delegate some of the details to others. In order to bring out the best that there is in a man, it is important not to make him feel that there is any doubt about his ability to do a certain job. On the contrary, he should be impressed with his superior's confidence that he can do it right. The results are often surprising. As a rule men will work harder to earn good-will and praise, than they will to avoid criticism; and they surely find more joy in the work, if the purpose is to win commendation rather than simply to avoid blame. While excessive praise is as objectionable as constant nagging, an executive should be as quick to commend good work as he is to find fault. In this way, many latent abilities may be brought out in men who otherwise would never have been suspected of great capacity.

The Value of Taking Men into Your Confidence

A plan that the writer has always found to work well, is to select some faithful, promising men in the organization and to let them understand that there are possibilities of better positions for them in the future in view of plans that are being made for expansion or changes that are always occurring in any progressive business. By so doing he will gradually direct the minds of these men into the channel which will later fit them for the position that he has in mind when the expansion of the business calls for an additional number of executives. Managers who claim that they get no response from their subordinates will be surprised to note the diligent and faithful efforts that most men will make in order to fit themselves for future jobs that will probably have to be filled from within the organization.

The Value of Consulting with Men in the Organization

When a change or rearrangement of a department is contemplated, the chief executive should not attempt to do all the planning himself—it is far better to tell the department foreman of the general plan and to ask him to make a sketch and a written proposal as to what he considers best. In nine cases out of ten his proposition will be a good one, because he understands many of the minor problems of the department with which the executive could not possibly have become familiar.

In buying new machinery when there is some doubt as to the size or make to be bought, it is often good policy, before deciding, to consult not only the foreman of the department where it is going to be used, but also the man who is going to run the machine. If it is a machine with which the foreman is not familiar, it is well to have him see it before it is actually bought. Greater efficiency will be obtained in that way. If the machine is bought with his approval, he will do everything in his power to make it a success. If it is bought against his wishes or without consulting him, he is very likely to find fault with it, not because he is of an unusually mean disposition, but because he is simply human.

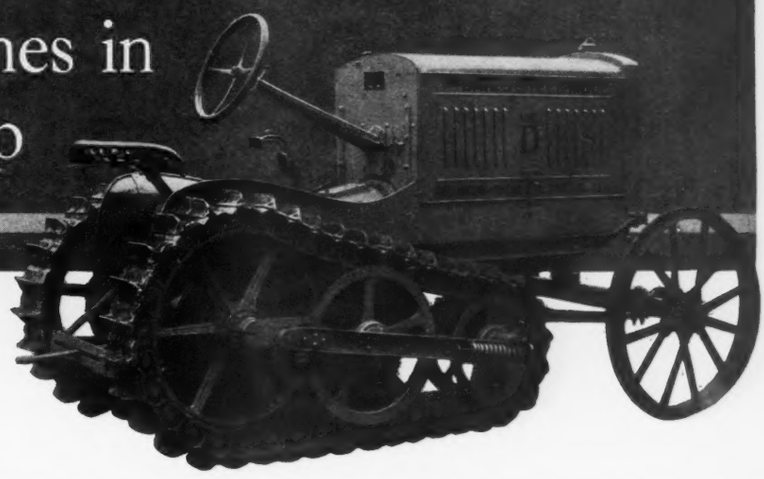
As an example of the value of consulting the shop man, the following incident will prove of interest. It was recently practically decided to buy a second-hand planer that was in exceptionally good condition and sold at a reasonable price. The man who was to run the planer was taken to a plant where the machine was for sale to see it. He was delighted with it and fairly beamed at the prospect of running such a fine, modern planer. But having thoroughly inspected it, he said, "I am afraid it will prove troublesome because there is no place to put it except on the present foundation, and it is so long that it will cut the shop in two and waste the time of every man who has to pass around it." That point had not occurred to the manager or to any of the executives who were supposed to have a "broad view" of things. Bear in mind that this man did not like to give up the prospect of running that fine planer, but it was evident that the plant meant more to him than just a place where he drew his pay.

An Understanding of Human Nature Makes Management Problems Simple

If every executive would remember when dealing with men that regardless of their station or accomplishment, their education or training, they are all inherently the same, having similar ambitions, hopes, and desires, and particularly very much the same emotions, they would be more successful in dealing with men. It is important to remember that most men are guided much more easily and more often by emotion than by careful thought and consideration. This will be questioned by some people who believe that everything they do is dictated by clear business judgment, but the fact remains that the world's business is to a considerable extent based upon action dictated by emotions.

Honesty of purpose is the simplest rule for successful dealing with men. The executive who puts his cards on the table, deals directly with his men, puts himself in the men's place, and acts in accordance with his own policies and not merely puts them on notices, will find that it is a good deal easier to manage men and to find men with good qualities and loyal tendencies than is ordinarily believed.

Special Machines in a Tractor Shop



Machines Designed by the Bates Machine & Tractor Co., Joliet, Ill., for Producing Tractor Parts

By EDWARD K. HAMMOND

IT will usually be found desirable to employ standard machine tools for the majority of the machining operations involved in the manufacture of metal products. The two chief reasons for their selection are that machines of standard design are less expensive than those which have been especially designed and constructed for a given purpose, and that standard machines can be utilized for many different operations instead of being restricted to one class of work. However, there are certain instances in which machines that have been built to meet the requirements of specified jobs are found far more efficient for their work than standard machine tools. As a general proposition, this is the case where a special design makes it possible to perform a number of operations simultaneously, and thus effect savings in production time, labor costs, and, by combining the functions of a number of machines in a single unit, greatly conserve the amount of floor space that is occupied by manufacturing equipment. The first cost of special machines of this type is usually quite high, and for that reason there must be a sufficient volume of work for the machines, if they are to earn a satisfactory return upon the investment.

Special Machines Used in a Tractor Plant

At the plant of the Bates Machine & Tractor Co., Joliet, Ill., a number of interesting special machine tools have been designed and built to meet this firm's requirements in producing certain parts of the "Steel Mule" tractor of its manufacture. These equipments have been developed for machining tractor parts of rather unusual form, but this article on the application of single-purpose machines will emphasize the possibilities of such a practice by manufacturers who at present are using nothing but standard equipment; and in certain cases, machines of very similar design to those which are described could be successfully employed for operation on numerous other parts, by merely making requisite changes in details of the design. Attention should be called to the fact that the satisfactory results that have been secured, are due to the care taken by experienced machine designers to make these equipments adapted for their work. Unless experienced men are able to devote a sufficient amount of time to the design of special machines to make suitable provisions for all special requirements of the job, it will be found the best practice to use standard machine tools in all cases, including those for which special machines might be found profitable under more favorable conditions.

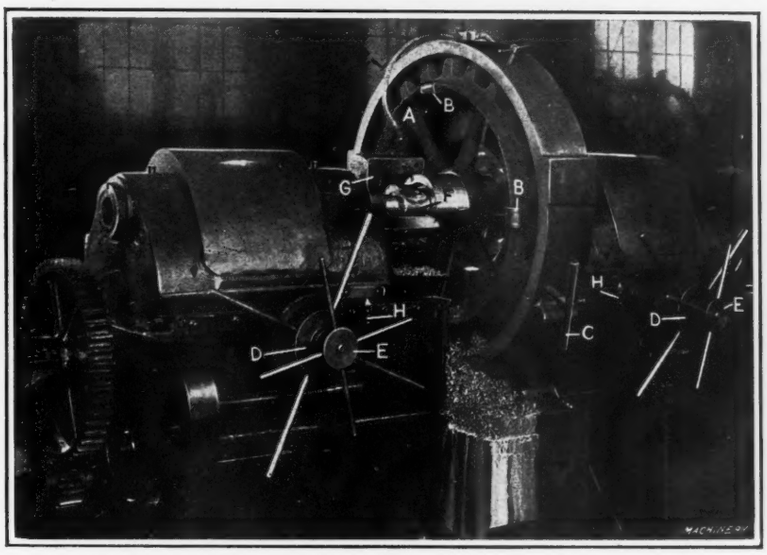


Fig. 1. Special Duplex Boring, Facing, and Turning Machine for finishing the Hubs of Cast-steel Driving Sprockets for Tractors

Machine for Boring, Turning, and Facing Hubs of Cast-steel Sprockets

On the Bates tractor, cast-steel driving sprockets are used, which are of the form shown set up on the machine at *A* in Fig. 1. The first step in machining is to bore and face the sprocket hub at one end, and to turn the outside of the hub to two different diameters at the opposite end, in addition to boring and facing. After gaining some experience with another method of performing these operations, it became apparent that much time would be saved if a special machine could be devised that would make it possible to operate simultaneously from both ends of the hub without requiring the piece to be reset. A duplex machine seemed to be the logical equipment for handling this job, and a machine of that type was built for the purpose. As shown in Fig. 1, it will be evident that the designers provided a chucking ring between the two opposed heads, inside of which the sprocket is held in position for machining. Four hooks *B*, which are actuated by bolts from the rear, clamp the work back against a flange inside of the chucking ring, and there are four radial screws *C* which project inward through the ring and center the work. Both of the heads on the machine are gear-driven and furnished with capstan wheels *D* for moving their position on the bed; capstan wheels *E* provide for engaging the power feeds when the cutting

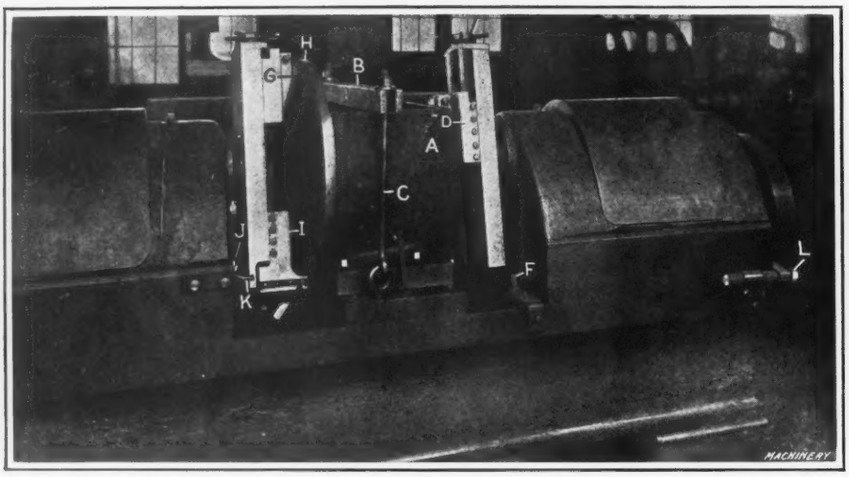


Fig. 2. Duplex Turning and Facing Machine for finishing Opposite Ends of Semi-steel Clutch Housings for Tractors

tools have been advanced into the desired position. By simply moving each head toward the work, provision is made for automatically engaging the gears of the driving train to start the spindle rotating; similarly, when the head is withdrawn from the work, the gears are disengaged and rotation of the spindle is stopped.

After the work has been set up as described, the method of procedure in performing the required machining operations is as follows: A number of tools are used for the performance of a sequence of operations, and to provide for the rapid setting up of these tools, the nose of each spindle is tapered and furnished with keys for driving the interchangeable tools that are made to slip over the spindle nose. At one end of the hub that is to be machined, a nicked and a smooth-toothed facing cutter are used for rough- and finish-facing the hub, respectively; then an inserted-tooth cutter rough-bores the hub, after which a reamer takes a finishing cut in the bore. Similar tools are used at the opposite side of the work for facing and boring, and a stepped cutter-head is set up on the spindle for use in turning the outside of the hub to two diameters as clearly shown in the illustration. This turning head operates simultaneously with the boring tools, being mounted on the spindle behind the boring tool *F*, as clearly shown at *G*. At each end of the hub, the bore is machined to a depth of 2¼ inches, and adjustable gages shown at *H* indicate when the cutters have entered the work to the desired depth. On this job the rate of production obtained is twelve sprockets in a ten-hour working day. Formerly the work was done on a lathe of standard design and as compared with this method, the saving effected by the special machine is $1.26 per sprocket.

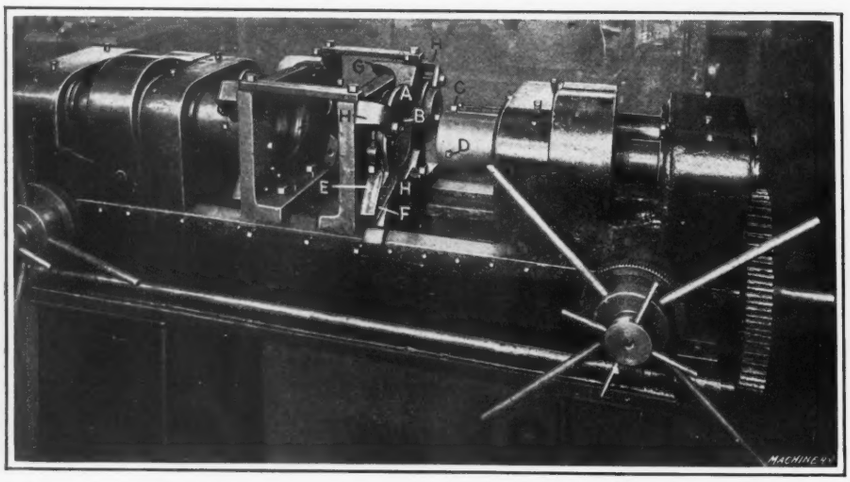


Fig. 3. Duplex Machine for simultaneously rough- and finish-boring Two Holes in Two Rear Axle Housings

Machine for Facing and Turning Semi-steel Clutch Housings

In Fig. 2, one of the semi-steel clutch housings to be machined is shown at *A*. Before they come to the machine, these pieces have been milled and drilled so that a locating surface is provided on which the work can be set up on a pad provided on the machine for that purpose. The desired location is secured by pins on the fixture which enter the drilled holes in the work. Clamping is accomplished by means of a strap *B* and bolt *C*. At the right-hand end, it is merely necessary to face the clutch housings, and for that purpose it will be seen that a rotary cutter-head is mounted on the spindle of the machine, this head being provided with a tool-block *D* that runs on a slide on the head. Feeding of the tool-block on this head is accomplished by means of a capstan wheel, mounted on the end of a screw, and a stop *F* secured to the lathe bed. For each revolution of the cutter-head, stop *F* engages the wheel, thus giving a transverse movement to the tool-block.

At the left-hand end there is a cutter-head of identical design to the one at the right, which provides for facing the vertical surface *G* on the work. In addition, it is necessary to turn the outside diameter *H* of the flange, and for that purpose a second tool-block *I* is mounted on a slide at the opposite end of the rotating cutter-head from that at which the facing tool is supported. This turning head is of similar design to the facing cutter-head, being furnished with a small capstan wheel *J* that strikes stop *K* and turns the capstan through one space for each revolution of the main spindle, thus imparting the desired feed movement to the turning tool carried by block *I*. The only difference between the turning and facing heads is that one moves in a direction perpendicular to the axis of rotation while the other moves parallel to this axis. On both the facing and turning operations one cut completes the job, there being approximately 3/32 inch of metal to be removed. After a casting has been set up on the machine, it is necessary to provide for bringing the cutters up to opposite ends of the work. Provision for doing so is made by having an adjusting screw *L* at each end of the machine. This screw runs in two lugs, one of which is secured to the bed, and the other to the head; and by turning the square end of the screw with a wrench, provision is made for advancing the heads to the work or withdrawing them after the turning and facing operations have been completed. On this job the rate of production obtained is twenty-two clutch housings in a ten-hour day.

Machine for Boring Cast-steel Rear Axle Housings

At *A* in Fig. 3, there is shown one of the cast-steel rear axle housings for a Bates tractor, and to provide for simultaneously boring the two holes in these parts the special machine shown in this illustration was developed. These housings are made in pairs, a right-hand and a left-hand housing being required for assembly in each tractor; and by equipping the machine with two opposed heads and a duplex work-holding fixture, provision is made for simultaneously boring two holes in a pair of housings. As it was originally built, and as still used at the plant, this machine has a cutter-head for working in each of

the holes, which is furnished with two bits, the first of which takes a roughing cut and the second a finishing cut in the hole. In the illustration, the bits on the cutter-head for working in hole *B* will be clearly seen at *C* and *D*.

It will be apparent that each of the opposed heads on this machine is furnished with a large capstan wheel that provides for advancing it to the work, and when the cutter-head has reached the desired point, the driving clutch is automatically engaged to start rotation of the spindle. The small capstan wheel at the center provides for engaging the power feed. As the castings come to this machine they have not had any preliminary operation performed on them. Location of the work in the fixture is accomplished by means of a channel *E*, which locates arm *F* on the work; and a second arm *G* prevents the casting from turning. Three straps *H* hold the casting back in place in the fixture. On this job the production is twenty-two pairs of rear axle housings in ten hours.

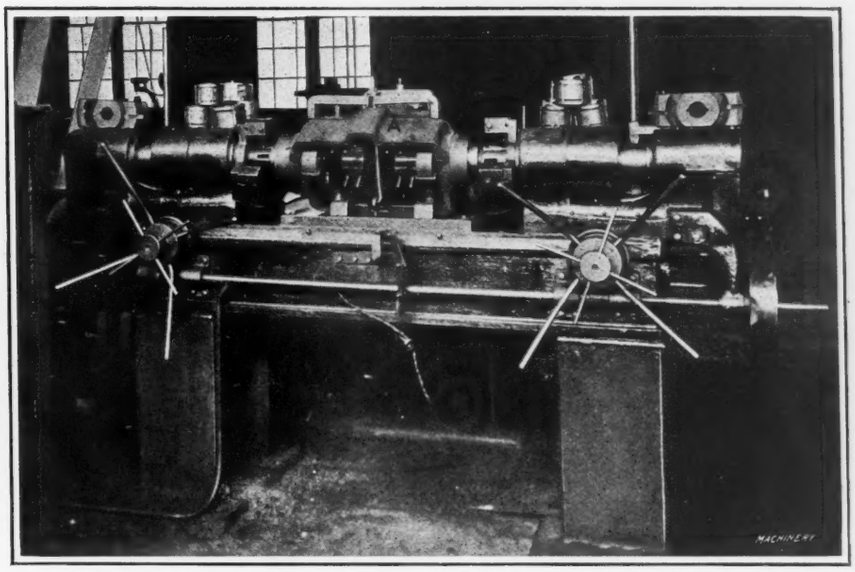


Fig. 4. Triplex Machine for Boring, Turning, and Facing Operations performed simultaneously from Three Directions on a Tractor Transmission Gear Case

Triplex Machine for Boring and Facing Cast-iron Transmission Cases

All of the machines which have been previously discussed have been so designed that provision is made for operating simultaneously from two sides of the work. In Fig. 4, there is shown a special machine designed for operation on transmission cases of the form illustrated at *A*, which makes it possible to work simultaneously from three sides of the casting. No emphasis need be laid upon the saving of time that is accomplished by such a principle of machine design. On this machine it will be evident that the arrangement of capstan wheels for automatically engaging the drive as the heads are advanced to the work, and for engaging the power feed, is the same as that on the machines shown in Figs. 1 and 3; but in addition, an auxiliary clutch has been provided to enable rotation of the spindle to be stopped at any point without requiring the head to be backed away from the work. As they come to this machine, the ends of the transmission cases have been straddle-milled on an Ingersoll miller, but these finished surfaces are not used as locating points. There is also a flange, shown at *B* in Fig. 6, which has been milled and drilled at a previous operation, and this is used as the locating point. A pad on the fixture engages the milled flange, and holes which have been drilled in the flange receive locating pins.

On these castings the operations to be performed are as follows: At each end of the casting, as shown in Fig. 6, it is necessary to turn the outside diameter of a hub *C* and to bore three holes *D*, *E*, and *F*, and also to face the inside end of a bearing which can just be seen at *G*. Machining operations also have to be performed at the back of the casting (as shown on the machine in Fig. 4), and for this purpose a third head is provided at the rear of the machine, as illustrated in Fig. 5. This head provides for boring hole *H*, Fig. 6, and facing the flange surrounding this hole, and also for facing flange *I*. In performing each of these machining operations, a roughing and finishing cut is taken, and in boring the fits to receive seven Timken roller bearings which enter holes *D*, *E*, *F*, and *H*, and three holes at the opposite ends, corresponding to *D*, *E*, and *F*, it is necessary to hold the diameter within a limit of 0.005 inch.

It will be apparent that in each of the holes *D*, *E* and *F*, one of the cutters is shown in the position it occupies in machining the opening in the work. Then the corresponding cutters for performing the finishing operations in these holes are shown at D_1, E_1, and F_1, respectively. The tool provided for turning the outside diameter of hub *C* is shown at C_1, while the tool for facing the end of bearing *G* is shown at G_1. All of these tools fit over a tapered spindle nose which is provided with keys to drive the tools; and in order to enable facing tool G_1 to reach the desired position on the work, an extension *K* is provided for the spindle, this extension being furnished with a tapered hole that fits over the spindle nose, while there is a corresponding taper at the end of the extension to enter the opening in the facing tool G_1.

Referring to Fig. 5, it will be evident that the head provided for operating on the work from the rear is mounted on ways which run at right angles to those supporting the two heads that operate on opposite ends of the transmission case casting. The rear cutter-head is furnished with a small

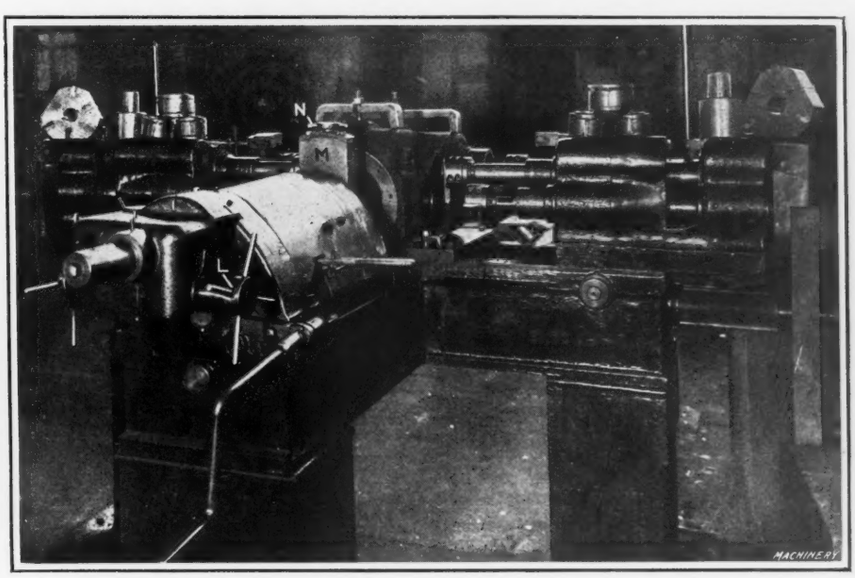


Fig. 5. Rear View of the Triplex Boring, Facing, and Turning Machine illustrated in Fig. 4, showing the Head for performing Boring and Facing Operations from the Rear

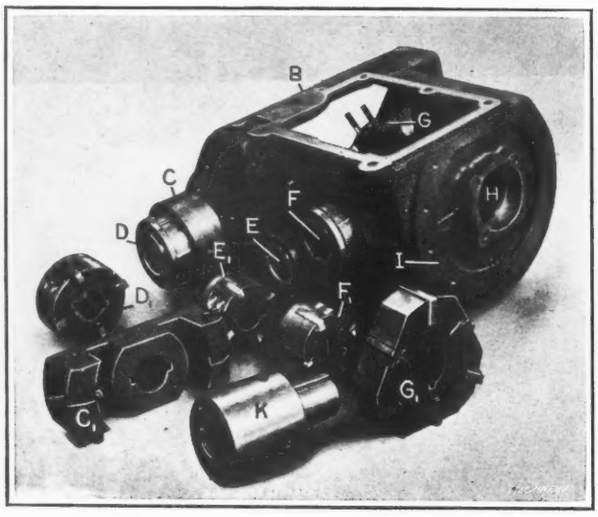


Fig. 6. One of the Transmission Gear Cases, showing the Operations to be performed and Tools used for Various Purposes

capstan wheel *L*, which is used to engage the power feed, and at the front end the spindle is tapered to provide for receiving the boring and facing tools which operate in the hole *H* and on the flange surrounding the hole, as shown in Fig. 6. For facing flange *I*, Fig. 6, it will be seen that there is a facing head *M*, Fig. 5, which is of similar design to the facing heads used on the machine shown in Fig. 2, this head being provided with a tool-block, mounted on a slide and actuated by a star feed that is operated by capstan wheel *N* striking a fixed stop secured to the bed of the machine. In this way the facing operation can be conveniently performed. On this job the rate of production obtained for performing the roughing and finishing operations in all of the different holes and on all of the different surfaces mentioned is twenty-one transmission case castings in a ten-hour day.

Machine for Drilling Cast-steel Caterpillar Shoes

Reference to the heading illustration, which shows a completely assembled Bates tractor, will give the reader a good idea of the way in which the caterpillar treads are assembled on the machine. There are two pivot holes which have to be drilled in each end of these treads, and Fig. 7 shows the work set up on a special machine that was designed and built for the performance of these drilling operations. The pieces of work *A* are mounted on a vertical turret, two of the caterpillar shoes to be drilled being held on each face of this turret by means of a strap *B*. Attention is called to the fact that the holes in the work, shown at *C* and *D*, do not extend all of the way through, so that the four drills carried by the spindles of each of the opposed heads can work simultaneously. In operating this machine the method of procedure is to have an operator stationed at each side. The man at one side of the machine sets up fresh castings in place on the turret while holes are being drilled in castings mounted on the adjacent face of the turret. While this drilling operation is proceeding, the operator at the other side of the machine is also busily engaged removing drilled pieces from the next face of the turret.

After the drilling operation has been completed, the turret locking pin is withdrawn by depressing a foot-pedal shown at *E*, which withdraws the locking pin *F* from one of the steel-bushed holes which are distributed around the turret to provide for locating it successively in the desired positions. The castings which have been set up at one side of the machine are then advanced into the drilling position, and after the turret has been relocated, the heads are advanced to the work and the power feed is engaged, the two operators can immediately busy themselves in setting up fresh castings on the unoccupied face of the turret and in removing drilled shoes, respectively. It will be apparent that a large capstan wheel, of the form mentioned in connection with the machines previously described, is used on this multiple drilling machine for advancing the heads to the work; and a smaller size capstan wheel provides for engaging the power feed. A similar pair of capstan wheels for operating the left-hand head is located at the opposite side of the machine. To provide for feeding the heads along the bed of the machine, the geared drive transmits power to the spindles by means of splines. Also, the spindles carrying different sized drills are driven at suitable speeds to give the proper peripheral cutting speed to the drills. The holes to be drilled are 1 9/16 and 1 1/32 inches in diameter, respectively, there being one hole of each size at each end of the casting. On this operation, the rate of production averages 500 drilled caterpillar shoes in a ten-hour working day.

* * *

INJECTOR FOR LUBRICATING ENGINE CYLINDERS

An injector suitable for feeding lubricants such as graphite, boiler compound, soapstone, and other powdered materials into cylinders, boiler feed-lines, etc., has recently been placed on the market by the Pulso Injector Co., Philadelphia, Pa. Among the various types of apparatus to which this device can be applied are steam, gas, gasoline and oil engines; steam hammers; suction pumps; and hydraulic and pneumatic systems. When graphite is used in the injector, no oil is mixed with it, the claim being made that oil envelops the particles of graphite and tends to prevent them from adhering to the surfaces to be lubricated and from filling up pores and cracks. It is further claimed that pure graphite will readily adhere to metal surfaces and form a veneer which virtually eliminates friction between the moving and the stationary parts. After sufficient graphite has been injected into a cylinder to give the proper amount of veneer, the injector is regulated to feed only enough graphite to maintain this amount.

Some of the reasons why graphite is an especially suitable lubricant for the types of apparatus mentioned are because it is non-explosive, decarbonizing, unaffected by heat, acids, or alkalies, and has no corroding or chemical action. When the injector is placed on pneumatic or hydraulic systems or on boiler-feed lines, it is located on the suction pipe so that the particles of graphite are carried with the air or fluids through the entire system.

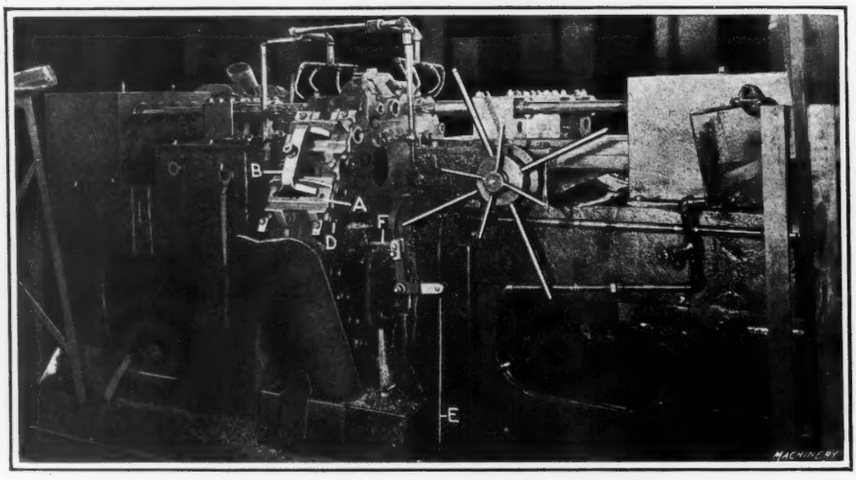


Fig. 7. Continuous Rotary Drilling Machine for simultaneously drilling Two Holes from Each End of Two Caterpillar Tractor Shoes

Relieving Attachment for Lathes

Device for Obtaining the Relief on Teeth of Formed Cutters

A DEVICE which can be attached to any thread-cutting lathe for turning the relief on the tops of the teeth of formed cutters is shown in the accompanying illustrations. This attachment, recently described in *Engineering*, has been developed by E. M. Wildey and is being manufactured by Messrs. Milton, Ltd., London, England. The tool is rocked alternately toward the work in order to produce the relief on each tooth. The attachment does not need to be removed from the machine in order to perform straight turning or threading operations.

Construction of Relieving Attachment

The attachment is designed to be mounted on the cross-slide, the main body *A*, Fig. 1, which is a steel casting, being supported on the gibbed plate *B*. This plate is bolted to the cross-slide. Body *A* is provided with a large hole through which the work, or the arbor on which the work is mounted, passes. Tools *C* and *D* are held in a slot on two oscillating toolposts *E* and *F*, respectively, by means of a nut and bolt. The tools can be operated simultaneously on the front and back of the work, although only the front tool *D* is employed in relieving operations, tool *C* being withdrawn so that it does not come in contact with the work as toolpost *E* oscillates. The toolposts are steel castings and are mounted on shafts *G* which are contained in the lower part of the body casting. These shafts have an eccentric on each end, and by turning these eccentrics, the toolposts are raised vertically. In this way it is possible to adjust the height of the tools to compensate for grinding. Transverse adjustment of the tools is effected by means of a stud *H*, which is fixed in each toolpost, and a knurled nut *I* mounted on each stud.

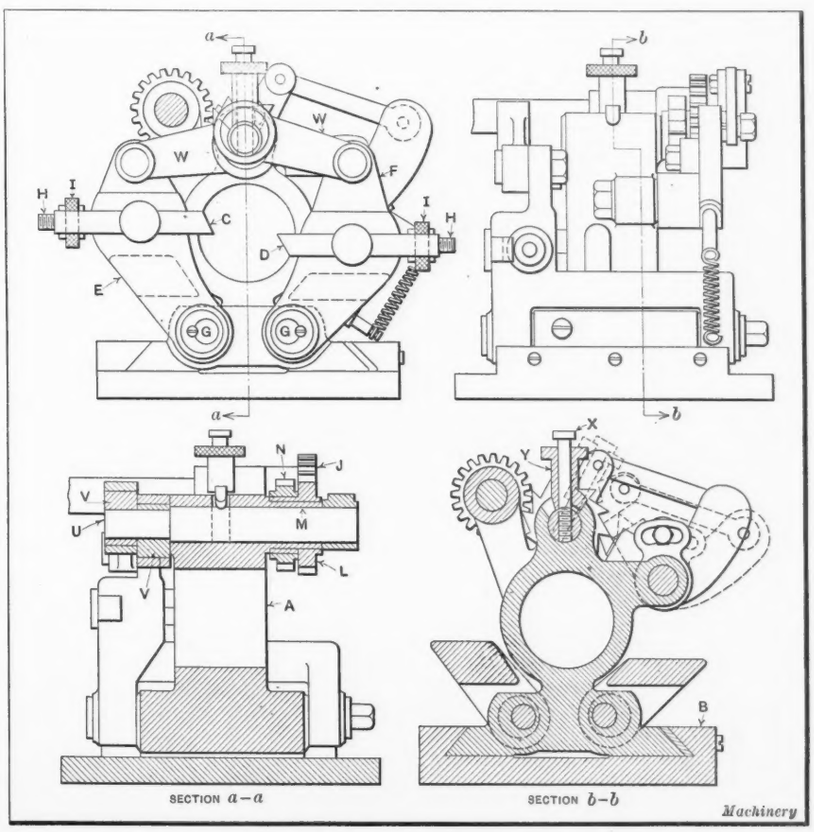


Fig. 1. Device designed for turning the Relief on Formed Cutter Teeth

The manner in which the rocking movement is given to the toolposts is as follows: The relieving attachment is driven by gears and a shaft which transmits motion from the faceplate of the lathe to gear *J*. The key of gear *J* slides in a long keyway on the driving shaft, thus permitting the whole attachment to follow the traverse of the lathe carriage in thread-cutting or other operations. Gear *J* meshes with gear *L* which is a loose fit on shaft bearing *M*. A ratchet-toothed cam *N* is secured on the hub of gear *L* and rotates with it. Cam *N* rotates at the same speed and in the same direction as the work, and has the same number of teeth as the work. The actual diameter of the cam and the shape of the teeth are immaterial, but the teeth must be similarly spaced to the teeth on the work and have feather edges. Special types of reamers and cutters in which the teeth are unequally spaced can also be relieved, but the teeth of the cam must, of course, be spaced correspondingly.

The teeth of cam *N* engage with an adjustable pawl mounted on one arm of the bellcrank lever *P*, Fig. 2, which is pivoted on body *A*. As the cam rotates in the direction indicated by the arrow, the arm of the bellcrank lever is pulled downward until the pawl escapes from one of the cam teeth, after which it is pulled up into engagement with the next tooth by the action of the light compression coil spring *Q*. The combined effect of the cam and spring is to impart an oscillating motion to the bellcrank lever. There is a groove in the opposite arm of lever *P* in which block *R* can be clamped in any position. One end of link *S* is connected to block *R*, while the other end is attached to arm *T* which is keyed on shaft *U*. Through the medium of these parts, the oscillating motion of the bellcrank lever is transmitted to shaft *U* and also through eccentrics *V*, Fig. 1, and links *W*, to toolposts *E* and *F*. A short spring *X*, Fig. 2, is placed between a projection on the toolposts and the main casting to take up any lost motion due to wear of the links, etc.

It is obvious that the position of block *R* in the groove of lever *P* determines the magnitude of the angular oscillations of shaft *U* and consequently those of the toolposts. However, by adjusting block *R*, the amount of relief can be varied independently of the shape of the cam. The actual amount of relief is indicated by a graduated scale on the arm of lever *P* which gives the amount of relief in millimeters. The oscillating motion, of course, ceases entirely when block *R* is brought down to the center of oscillation of the bellcrank lever, and this enables plain turning or thread-cutting operations to be performed without removing the attachment from the lathe. The forward and backward movement of the tool used for relieving is ordinarily limited by bolt *X*, Fig. 1, which is screwed into shaft *U*, and the

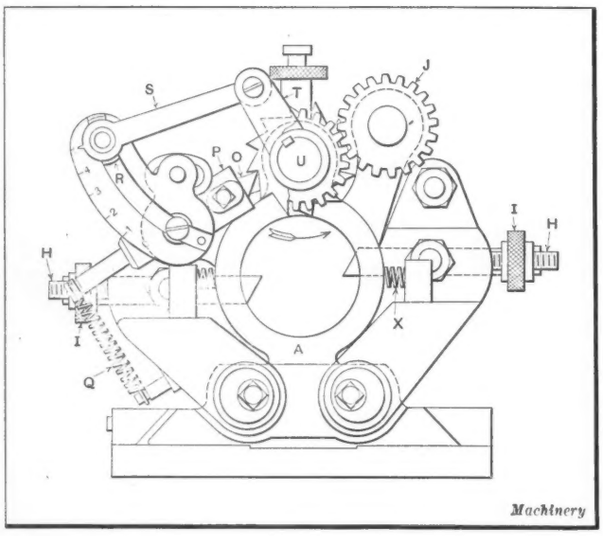


Fig. 2. View of Right End of Attachment showing Oscillating Mechanism

sliding sleeve *Y* which is mounted on the bolt. The lower end of the sleeve is machined to suit a slot in the main body casting, and the movement of the tool is limited by the sleeve coming in contact with the ends of the slot. The tool, however, can be brought sufficiently clear of the work to permit the lathe carriage to be returned to the position for commencing a new cut, without altering the setting of the tool in the toolpost. This is accomplished by withdrawing sleeve *Y* from the slot in the main body, which permits spring *Q*, Fig. 2, to swivel lever *P* on its bearing into the position indicated by the dotted lines in section *b–b*, Fig. 1. This effects the withdrawal of pawl *O*, Fig. 2, from engagement with the cam and permits a greater motion to be given to shaft *U* by moving block *R* in the groove in lever *P*, which, of course, increases the movement of the tool. This is particularly advantageous when relieving threaded hobs.

Application of the Device for Straight Turning and Threading Operations

As previously mentioned, only tool *D*, Fig. 1, is used in relieving operations, but when performing plain turning or threading operations both tools are employed. In the latter case it is convenient to be able to feed both tools into the work simultaneously and to withdraw them together at the end of a cut. To accomplish this purpose toolpost *E* is connected to the oscillating mechanism in a similar manner to toolpost *F*. When operating both tools, the pawl is disengaged from contact with the cam in the way previously described when dealing with the method of backing the tools away from the work in order to return the carriage to the starting position. After the pawl has been disengaged, tools *D* and *E* can be operated simultaneously either forward or backward by simply moving block *R*, Fig. 2, up or down, as the case may be, in the groove in lever *P*. Thus it will be seen that it is a simple matter to adapt the device for straight turning and threading operations.

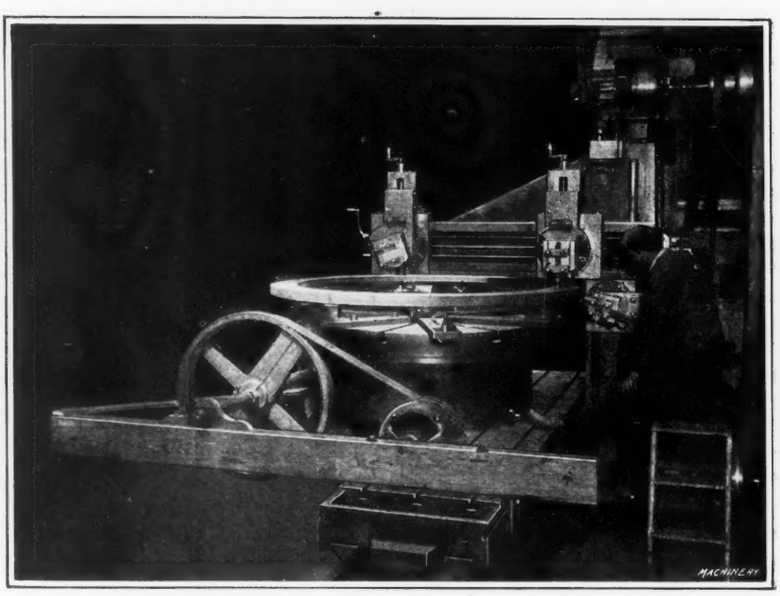
An important advantage of the pivoting tool-holder used in this relieving attachment, over the horizontal slide of an ordinary relieving lathe, is that in the former the tools can be so adjusted that the cutting angle remains constant at all stages of the cut. Consequently, greater cutting efficiency is obtained and a tool with less clearance can be employed. The attachment has been designed for handling work up to 2¼ inches in diameter.

USING AN OPEN-SIDE PLANER AS A BORING MILL

In manufacturing a special universal hobbing machine to generate gears up to 96 inches in diameter and 36 inches face width in the works of the Newark Gear Cutting Machine Co., Newark, N. J., it was found that the large faceplate and the upper and lower rings of the index worm-gear blank were larger than the capacity of the laregst boring mill in the plant. On first consideration, it appeared as though it would be necessary to either have the parts machined in some shop with a larger boring mill, or machine these parts directly on the hobbing machine by equipping it with toolholders and slides. From the accompanying illustration, it is evident that none of these methods were resorted to, but instead a "Liberty" open-side planer was adapted for the work as shown.

This large universal hobbing machine, strictly speaking, was not designed in each particular as a new 96-inch by 36-inch capacity machine, but was in many respects an adaptation of a smaller machine for the work, as it had been determined that the smaller machine was sufficiently rigid and powerful to withstand the strains and stresses and deliver the required power. The work-table of the smaller machine was readily adapted for handling the larger work by mounting a large faceplate on it.

As a larger capacity machine requires an index worm-gear of a larger diameter to maintain the required accuracy, this index worm-gear blank was made of two rings secured to the large faceplate. The problem of machining the faceplate and index worm-gear blank rings was solved by fastening to the planer table the work-table which is to be equipped with the larger faceplate on the new machine. To secure the rotary motion, the hobbing machine work-table was temporarily equipped with the index worm and index worm-gear regularly applied to a smaller hobbing machine. A pulley was placed on the temporary worm-shaft, driven by a motor bolted to the planer table; the only special parts necessary were three supports of wood. The regular planer feeds were used. By performing the turning, boring, and facing of the faceplate and rings directly on the work-table to which these parts were afterward permanently secured, accuracy was more easily obtained than would have been the case had a boring mill been used, and it required but little time to set up the machine for this work. The accompanying illustration shows the upper index gear blank ring being faced and turned on the "Liberty" open-side planer, equipped in the manner described in the foregoing.



Using a "Liberty" Open-side Planer as a Boring Mill in the Plant of the Newark Gear Cutting Machine Co.

MACHINE FOR CUTTING OFF AND COUNTERBORING TUBING

By JOHN A. H. PHILLIPS

In a certain plant, the demand for large quantities of cylindrical pieces led to the designing and building of a special machine, which was equipped with the chuck and counterbore shown in the accompanying illustrations. With this machine, the required pieces were satisfactorily produced by cutting off and counterboring tubing 6 inches in diameter, having a wall thickness of 3/16 inch. In order to meet the requirements, it was necessary that the finished cylindrical pieces be cut to various specified lengths and be accurately counterbored to a depth of 5/16 inch from each end. As the peripheries of the cylindrical pieces were required to rotate concentrically about bearings fitted into the counterbored holes, it was necessary to provide a chuck for holding the work, which would not only hold the tubing firmly and in accurate alignment with the counterboring tool, but which would also bear evenly at all points on the circumference of the tube and at the same time possess sufficient strength to force the tubing into shape in case it should be out of round when inserted in the chuck.

The chuck developed for this purpose, which was found to provide sufficient gripping power, is shown in Fig. 1. As the tubes were held inside the chuck body, this chuck eliminated the necessity of providing any additional means of support for tubes up to 20 feet in length. In order to provide a suitable foundation for the chuck, the head was removed from an old type 16-inch lathe. The tailstock of the lathe, however, was retained in order to provide a suitable means for holding the special counterboring tool shown in Fig. 2. The regular handle was removed from the tailstock and replaced with a 10-inch handwheel in order to give the operator better control over the tool when feeding it forward. The carriage was also retained for the purpose of holding the cutting-off tool, which was of the ordinary forged type. The power feed was eliminated, and a series of gears *F*, Fig. 1, installed to provide a suitable means of driving the spindle from the back-gear shaft at a speed previously found to give the best results. This shaft was equipped with tight and loose pulleys, and a belt shipper *H* was provided for shifting the belt. The bearings were all fitted with bronze bushings, the two spindle bearings being split to allow adjustment for wear.

The chuck, which is of the cam type, is constructed as indicated by the detail and assembly views in Fig. 1. The spindle *A* contains two sets of milled radial slots *I*, which form the bearings for the jaws *C*, of which there are sixteen. These jaws are kept in contact with the cams *L* in the two rings *B* by means of two springs *E*. A thin steel plate *P* is attached to the front end of the chuck body by means of machine screws, in order to keep the front row of jaws in position. Three studs *J* having right- and left-hand threads hold the two cam-rings together. When in operation, the tube is inserted and the screw *K* given about three turns with a chuck wrench. Sufficient gripping power is thus obtained by closing the jaws to hold the work firmly in place without danger of slippage. It will be noted that the adjusting screw acts against the dog *D*, which is bolted to the spindle and which remains stationary, preventing the inner ring *B* from becoming disassembled while both the cam-rings revolve. To remove the tube, the screw *K* is loosened, and a slight downward pull on the wrench is given to free the jaws and release the work.

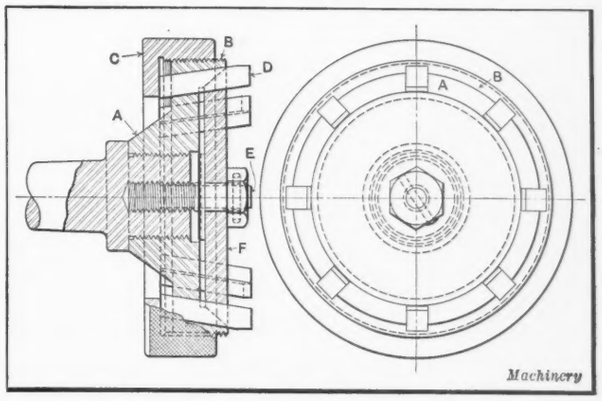


Fig. 2. Tool used to counterbore 6-inch Tubing

A second machine was built soon after the first one was put in operation and after four years of almost continuous service these machines remained in very good condition. One of the machines has been used with equal success on tubing of much smaller diameter by simply making a set of jaws of suitable length.

The counterbore shown in Fig. 2 is held in the tailstock, as previously stated, being prevented from turning by means of a pin located in the shank, which fits into a slot in the tailstock sleeve. The boring head proper is built up of two parts *A* and *B*, in order to facilitate machining. After turning the inner member *A* to the required size and milling the eight cutter slots, the outer section *B* is bored and shrunk on over part *A*. The cutters *D* are hardened and ground all over. After pinning the two body members together, the outer member is turned and threaded to fit the adjusting ring *C*. After assembling the tool, the adjusting ring is turned back as far as possible without subjecting it to the danger of loosening, in which position the cutters are clamped in place by means of screw *E* and disk *F*, and then ground. When the cutters become dull, it is a simple matter to readjust and grind them. In order to move the cutters forward, it is only necessary to loosen the clamping screw and turn the adjusting ring.

The construction of this tool is such that the cutters can be advanced and ground without changing the size of the counterbore. If desired, the diameter of the bore may be changed a small amount after grinding as conditions may require, by simply adjusting the ring. The machine described was provided with two of these tools having cutters 2¾ inches long. One set of cutters in each of the tools was in continual operation for more than a year on work which required the counterboring of 6-inch tubes to a length of 5/16 inch and a depth of about 3/32 inch. By the use of these machines it was possible to attain a production rate of 500 tubes every twenty-four hours.

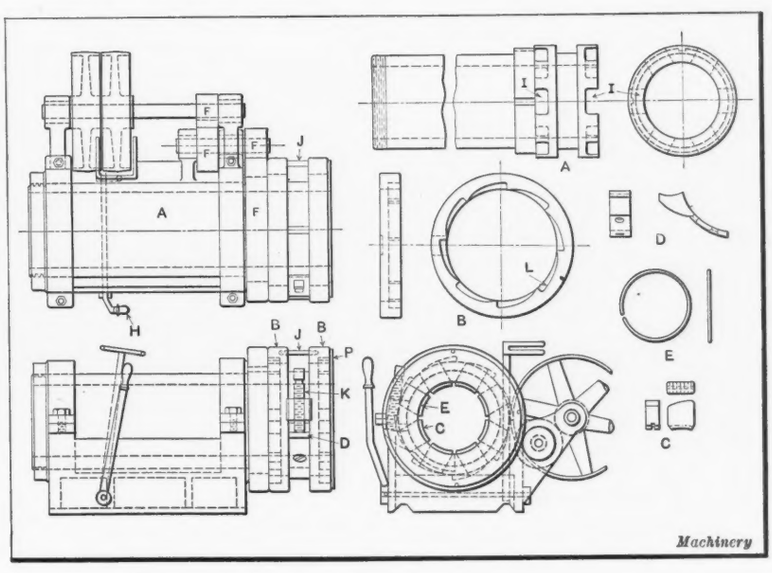


Fig. 1. Chuck employed to hold Tubing during Cutting-off and Counterboring Operations

Simplified Recording System for Maintenance Work

By ARTHUR F. OWEN

IN most factories having a maintenance or upkeep department, the responsibility of the entire factory upkeep is placed on one man, who is usually designated master mechanic or superintendent of maintenance. It is essential that this man be able to ascertain quickly the status of any or all machinery and equipment, either by department or by individual machine. When the production department requests a certain additional piece of equipment or a new machine tool, it is necessary that the cost of upkeep and repair, as well as the initial cost, be carefully considered. It is well known that certain makes or types of machines of standard sizes and capacities prove superior in economy, on account of the low erection and repair costs. For this reason records showing these data are invaluable to the maintenance superintendent. There is also a further use for this information, namely, it can be used to check time slips turned in by the repair and erection crews on similar repairs or erections at a later date. A simple filing card such as shown in Fig. 1 gives all necessary information regarding the upkeep cost of the individual machine or appliance. This card, as will be noted, has spaces for the time used in making the repairs, etc., so that it gives a complete record of the actual upkeep cost of the individual machine. In most shops the machines are numbered, and this number, as well as the number of the department and the general description of the machine, should appear on the card. Then by referring to a general lay-out drawing, the maintenance superintendent can readily ascertain the location of the machine, etc.

146 MACH. NO. — Atlas 14 Spindle Drill DESCRIPTION

6 DEP'T

MAINTENANCE RECORD

DATE	REPAIRS	CAUSE	PARTS USED	MAN NO.	TIME
5-26-18	Feed gear	Operator	Feed gear and key	1868	3 hrs 15 min
6-14-18	Feed shaft bush.	no oil	Bushing	1868	1 hr 35 min
7-18-18	Counterweight chain	wear	New chain	1868	7 hrs 30 min
7-20-18	Oil pump clogged	waste in oil tank	None	179	15 min
9-16-19	Feed gear	Operator	Feed gear	1600	3 hrs 45 min
					Machinery

Fig. 1. Sample Filing Card showing Upkeep Cost of Drilling Machine

The maintenance departments of large and medium-sized plants are usually composed of millwrights, belt men, tinsmiths, plumbers, electricians, yard men, laborers, sweepers, and janitors. The great variety of work which this department handles makes necessary a simple system of reporting and recording work to be done. For this purpose the card shown in Fig. 2 may be supplied to department foremen. When a machine is to be repaired, a belt tightened or replaced, a new electric light installed, or any other job which is taken care of by the maintenance department needs to be done, the foreman of the department requiring this work simply fills in the machine number, department number, and date, and checks the nature of the work wanted. He then turns the card in to the maintenance department, where the job is numbered and a man, or gang of men if necessary, is despatched to attend to the work. The workman's number is entered on the lower portion of the card, and this portion is torn off and given to him so that the time consumed in making the repair can be entered on it by him upon the completion of the work. As the material used on any repair job is usually withdrawn from stock on a requisition stating either the job number or the purpose for which it is to be used, it is unnecessary for the workman to make any record of stock used on the job. At the time of assignment, the upper portion of the card is either hung upon a board, each card being placed on an individual nail assigned to the workman; or, the cards may be filed in a rack where they are instantly available. These upper portions of the cards show, at a glance, just where each job with its workman or crew of workmen is located, and the work they are engaged in; hence it is a comparatively easy matter for the supervisor or foreman to determine where men may be obtained to meet an emergency or breakdown, with the least inconvenience or hindrance to production.

When the repair job is completed, the man in charge of the work turns in the lower portion of the card with the time consumed entered upon it. The upper portion is then stamped "Completed," and returned to the foreman in whose department the work was done, giving him a record of its completion. The advantage of this method over the older system of written orders and requisitions, with the troubles caused by lost orders, illegible writing, and consequent misunderstandings, is apparent. Furthermore, it is a constant reminder to the maintenance superintendent of the work in progress and its urgency. Of course, on large erection and installation jobs, which require the services of a large crew, an additional card may be attached with a paper clip, showing material ordered, sequence of the operations to be performed, and the names of the men in each branch or trade who are responsible for carrying out the work.

Besides a system of notification and record of maintenance jobs, data should be gathered as to the speeds, sizes, etc., of lineshafts in each department, electric motor equipment, etc. These data are absolutely essential to an efficient maintenance department, and if not at hand, a check of the lineshaft speed by a millwright or other mechanic, consuming anywhere from fifteen to forty-five minutes, must be made when ordering new equipment. It is commonplace things like these that are so apt to be slighted in maintenance work. Drawings showing machine lay-outs, pipe lines, and sizes and locations of valves, etc., are time-savers, and if they are drawn to scale, many accurate estimates of proposed changes or extensions may be made from them, which will eliminate considerable tedious measuring and tracing of existing lines. A simple set of standard bolts, struts, and beams with which to hang countershafts may easily be prepared for use in plants where some uniformity of structural details in the different departments or buildings exists. Of course, in countershaft erection, many deviations may be expected, but the time saved in laying out and measuring, and procuring suitable materials is greatly reduced by keeping on hand a supply of standard bolts and beams of various sizes and lengths.

WORK REQUISITION

146 MACHINE NUMBER — 6 DEPARTMENT

5-26 19-18 DATE

✓	MACHINE REPAIRMAN	✓	HOLDING UP PRODUCTION
	BELT MAN		URGENT
	OILER		REGULAR
	ELECTRICIAN		NOON HOUR
	PLUMBER		OVER-TIME
	TINSMITH		NIGHT
	CARPENTER		SUNDAY
	LABORER		WARNING ONLY
	SWEEPER	✓	SEE DEP'T FOREMAN
	SPECIAL		
	SPECIAL		
	STAMP WHEN COMPLETED COMPLETED		

NATURE OF WORK- feed gear broken must be repaired or replaced

Robt Miller FOREMAN

TEAR HERE

146 MACH. NO.	6 DEP'T	741-A JOB NO.	5-26-18 DATE

WORK DONE

DESCRIPTION	MAN NO.	TIME
Put in new feed gear and key	1868	3 hrs - 15 min

REMARKS- feed gears O.K. but operators are careless in this Dept

MacMinery

Fig. 2. Card supplied to Department Foremen on which Requisitions for Repairs are written

Oiling is a task usually performed by one or more men, who are constantly going from one department to another. Sometimes they are responsible for the polishing of the shafting as well. Usually these men are proficient and rarely skip a bearing, but there is a possibility, in the event of a new man being employed on the job, that bearings will be passed over without oiling. In one large plant, a complete oiling schedule was worked out, which not only furnished the oiler with the requirements in each department, and scheduled or arranged his work so that all bearings were oiled regularly, but also enabled the maintenance superintendent to locate his men at any time during the day.

The department bulletin board is almost an absolute necessity in maintenance work. On it may be posted the names or numbers of workmen wanted for over-time work, etc., also information which should be generally known to workers in this department. As the workers are usually scattered over the entire plant during working hours, the superintendent will find the bulletin board a convenient means of giving out such information as will be helpful to the department in general. By using a few simple methods of control, such as are here mentioned, the work of the maintenance department can be made more efficient, the production of the plant thereby assisted and increased, and the overtaxed superintendent of maintenance relieved of a great many worries.

* * *

A computation of the distribution of the various metals in the crust of the earth indicates that about 1½ per cent of the weight consists of iron and about 5 per cent of aluminum. Of the various chemical elements, oxygen enters into the crust of the earth, into water, and the atmosphere to a weight of more than the combined weight of all other elements, and hydrogen is about 16 per cent of the total.

SLIP-FRICTION WRENCHES

By GEORGE C. HANNEMAN

The extreme amount of care and accuracy required in the construction of airplane motors is quite well known. The production of these motors in large quantities during the war led to means being devised for obtaining an even amount of tightness in the bolts which secure the main crankshaft bearing caps in place. This point, which caused considerable trouble, would not have been noticed on the average kind of work, but since extreme accuracy must be maintained in these bearings it was found necessary, when placing the crankshaft in position, to devise a wrench which would tighten these bolts to the same degree as was obtained in the final reaming operation.

Experiments were made with various forms of slip-friction devices—cylindrical, flat disk, and cone, in combination with a T-socket wrench. It was found that the type of wrench shown in Fig. 1 gave the best results and that it was possible to set the friction to release within narrower limits than could be obtained by the use of any other type, and also that it would hold its adjustment longer after having been set. This wrench consists of a socket *A* which fits the nut and which may be made either in one piece as shown, or as a two-piece construction; in either case there should be a cone at its upper end as shown in the illustration. The cone is held in the holder *B* by means of the retaining collar-nut *C*, and is locked by means of the check-nut *D*. Between the sides of the cone and the conical seat in the holder a liner of thin sheet fiber is interposed as at *E*, and a fiber washer *F* is also employed in the retaining collar as a seat for the head of the cone. The fiber should be filed smooth before being used. By adjusting nut *C*, the wrench may be set to slip when the nut on the motor is tightened to a predetermined degree.

Various lubricants were tried on the fiber contact pieces, with the result that the best lubricant for increasing the length of service to which the wrench could be subjected without requiring adjustment was found to be dry graphite. Greases and oils caused the wrench to stick when being used after lying idle for some time.

Method of Setting Wrenches so as to Produce Slippage when Subjected to a Known Torsional Stress

The construction of the wrench, however, did not entirely solve the problem, because it then became necessary to determine just how much stress was required and to devise the means for setting the wrenches to correspond with this known amount. This would enable quantities of wrenches to be adjusted to the same degree so that each workman could be supplied with an individual wrench, interchangeable, so far as slippage was concerned, with all the others in the factory. To measure the amount of torsion required to cause the wrench to slip, the gage shown in Fig. 2 was devised. This is simply a tension spring stretched by a lever

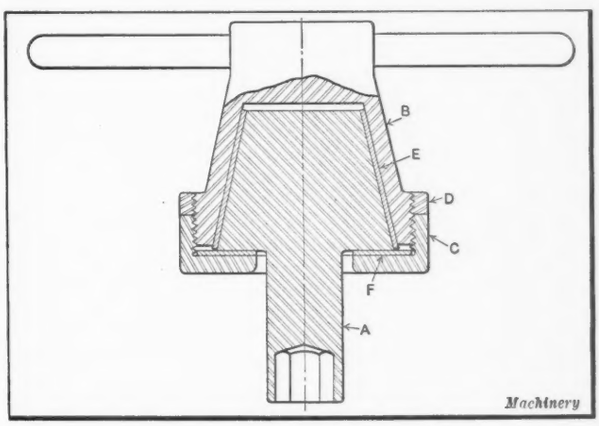


Fig. 1. Socket Wrench designed to slip when a Certain Amount of Stress is applied

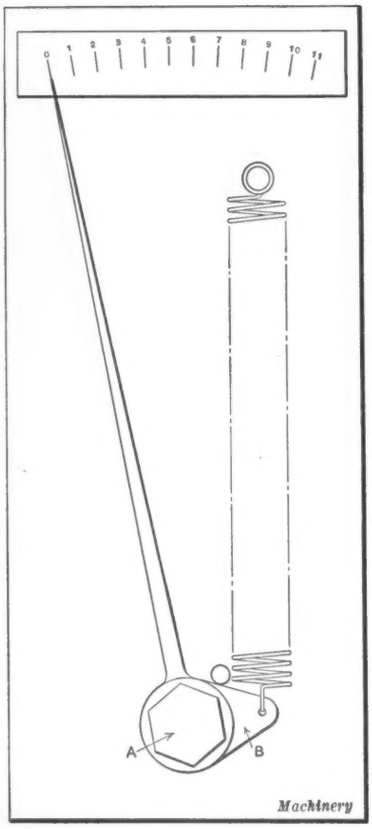


Fig. 2. Gage for measuring the Amount of Torsion which will cause Slippage in Wrench

arm *B*, and operated by the friction wrench. The wrench is simply set over the nut at *A* and turned until it slips, causing the pointer to move across the graduated scale until slippage occurs; the more the wrench is tightened, the further the pointer will move across the scale. By adjusting the collar and nut on the wrench, slippage can be made to take place at any desired torsional stress.

The graduations on the scale read directly in foot-pounds of torsion, and are located on the gage by means of the arrangement shown in Fig. 3. This consists simply of a bar having a hexagonal hole in one end which fits over the nut *A* of the gage shown in Fig. 2, and which has a small round hole located 12 inches from the center of this hexagonal hole. The lever is placed on the gage, a spring scale hooked in the round hole as shown in the illustration, and the foot-pound graduations marked off on the scale of the gage to correspond with the spring scale readings; that is, 1 pound on the spring scale represents 1 foot-pound on the gage, etc. In this way every wrench can be set to the same degree, with the assurance that uniform results will be obtained with any of the various wrenches employed. The operator must, of course, be instructed to turn the wrench until it slips. All the wrenches are numbered, inspected every morning, adjusted when required, and a written report made showing both the condition in which the wrench was found when inspected, and the condition in which it was placed by the inspector. The accuracy of the wrenches will vary when new for the first few days, but after they have been used and limbered up a little very little adjustment is required. In order to be sure that the action of the gages is correct, they should be checked occasionally by means of the lever and spring scale, as described in connection with the illustration Fig. 3.

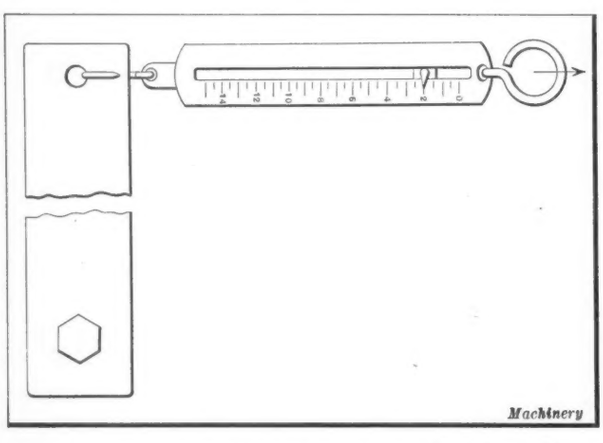


Fig. 3. Simple Method used when graduating Test Gage Scale shown in Fig. 2

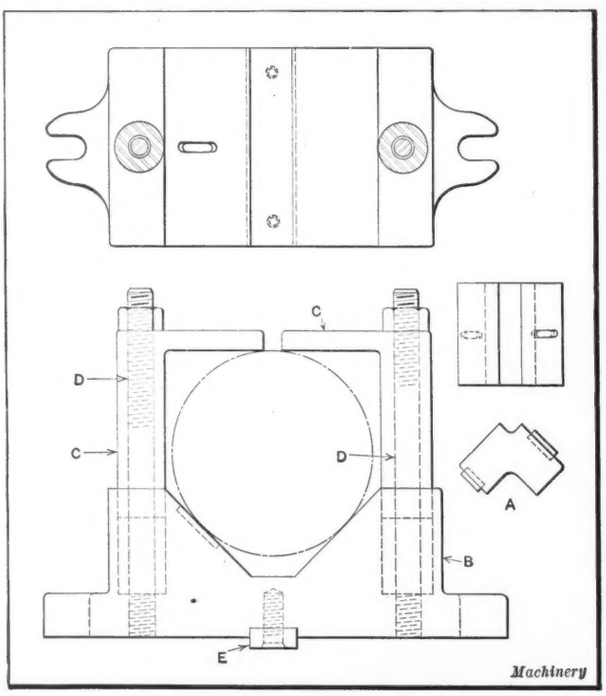
Stud-setting

Another use to which this type of wrench may advantageously be put is setting studs. The difficulties commonly experienced in this work were almost entirely obviated by the use of the slip-friction wrench. These wrenches were made the same as those shown in Fig. 1, except that a spring-action automatic drill chuck was fitted to the lower end in place of the regular socket. Each man was provided with one of these wrenches and each inspector was also furnished with a wrench, different from the workmen's wrench only in that it was set to slip when subjected to a smaller amount of torsion. Thus, if the inspector found it possible to turn a stud with his wrench it showed plainly that the workman's wrench had not been turned sufficiently to slip.

* * *

V-BLOCK FOR MILLING OPERATIONS

The accompanying illustration shows a type of V-block which has proved useful in performing several operations on milling machines. Before using V-blocks of this design, the writer had considerable trouble in keeping the work from shifting while milling long keyways in shafts. However, by the use of a number of the V-blocks illustrated, which were spaced along the length of the shaft, no trouble from this source was experienced and the machining of the work was



V-block used in milling Splines on Cylindrical Work

readily accomplished. The number of V-blocks required for holding the work depends upon the length of the shaft and the depth of cut to be taken.

The device consists essentially of a base *B*, which has a V-groove on the upper side, and clamps *C*, which secure the work to the base. These clamps extend into counterbored holes in base *B*, and are tightened on the work by means of the nuts on the screws *D*, which are attached to the base. The tongue *E* provides means for aligning the V-block with the table of the milling machine. This tongue is removable, so that one of another size and shape can be substituted when it is desired to place the V-block on a machine table having either narrower or wider slots. A small reversible block, drawn to a smaller scale than the V-block, is shown at *A*. This block is machined to fit the groove in base *B* and is provided with keys that fit a corresponding keyway on one of the groove surfaces. By means of this reversible block, the larger V-block can be readily made to accommodate work of smaller diameters. R. F. M.

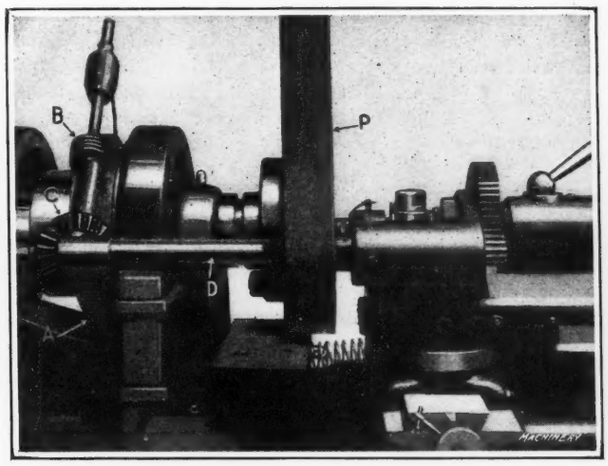


Fig. 1. Thread Milling Attachment used to rough-mill Gage Blanks

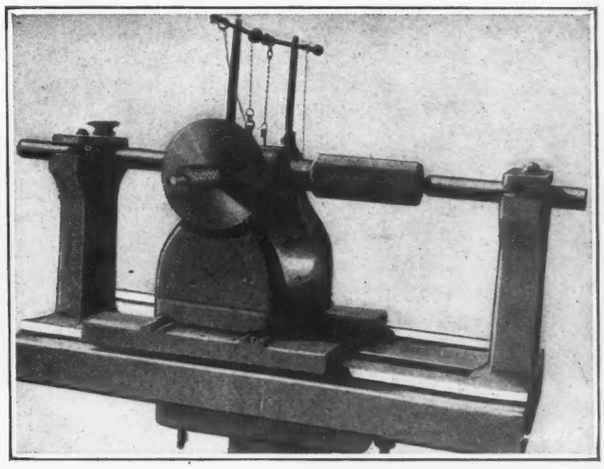


Fig. 2. Apparatus employed in testing the Pitch and Root Diameters

Making Whitworth Thread Gages

Method which Utilizes the Disintegration of the Grinding Wheel During the Grinding Operation to Produce the Final Thread Form

By C. EDGAR ALLEN

ONE of the mechanical problems met with in Great Britain during the war was that of producing plug gages for Whitworth threads in large quantities within the required limits of accuracy. The difficulties that are usually experienced in the quantity production of parts having this form of thread are considerably increased in the manufacture of these gages, due to the fact that the threads become distorted by the hardening process and must be finished by either lapping or grinding. While accuracy and surfaces of good quality are obtained by lapping, the rate of production by this method is slow, and for this reason it was apparent that some other method of truing the threads must be resorted to in order to produce the gages rapidly.

It was evident that if some satisfactory means of grinding the threads accurately could be found, the problem would be solved. While the United States form of thread is often ground, the problem of grinding the Whitworth form is more complex on account of the rounded crests and roots of the latter. For this reason, the United States form of thread can be more readily produced by a form grinding wheel than the Whitworth, and the wheel dressing fixture used in connection with grinding the former type of thread can be of a much simpler design than the device necessary to true the wheel used for grinding Whitworth threads.

After considerable experimenting, J. H. Jones, of Newport, England, developed a method by which Whitworth threads could be ground to the correct contour. This method is based upon the fact that while a grinding wheel having a simple angular edge loses its edge by wear, it nevertheless gradually assumes a shape which will produce an approximately true tooth form. At first the experiments along this line were unsuccessful, but it was finally discovered that by using a wheel to grind the root forms and sides of the thread, and another wheel to form the crests, the true thread form could be produced.

Process Employed in Grinding Threads to Correct Form

In grinding a thread that has been rough-shaped by milling, a wheel, the edge of which has been dressed to an angle as shown at *A* in Fig. 3, is fed into the work and traversed through the threads. After the wheel has traversed across the thread several times, the edge becomes rounded as shown at *B*. The wheel is then again dressed to a fine angular edge and the process repeated until the sides and root of the thread reach the required form and limits. Suitable adjustments of the work and wheel speeds are necessary in order to give the requisite initial wear, and special conditions of rigidity and accuracy are required in the mounting of the wheel. The crests of the threads are produced in a manner similar to that used to generate the roots and flanks except that the face angle of the wheel is enlarged to 85 degrees or more in order to provide contact with two adjacent crest corners. After a few traverses of the wheel, the condition of the crest becomes similar to that of the crests on the threads to the right of the wheel shown at *C*, which are roughly polygonal. The curvatures on the wheel and the work gradually develop after repeated traverses of the wheel until the edge of the wheel and the crest of the thread become as shown at *D*. Finally, the thread is produced to the true form which is shown at *E*, while a corresponding concavity is produced on the edge of the wheel. As in the previous operation, occasional applications of a wheel dresser are necessary to restore an easy wearing condition on the wheel.

Continuous inspection of the work is necessary until the required form and limits have been reached, and it is the exactness of this process of inspection rather than the actual manipulation of the machine employed in grinding the threads that determines the accuracy of the work. For this reason, women operators, suitably selected and trained, were found satisfactory.

The process just described has been criticized because it belongs to the "cut and try" category, and is therefore lacking in those positive features so desirable in quantity production. The same objection, however, may be urged against lapping and, in some cases, even cylindrical grinding, since the progress of such work must also be continually tested by a working gage or some suitable gaging method. This much may be said, however, that whatever drawbacks the method may have, the results achieved entitle it to recognition. During a period of three years, from 150 to 200 hardened gages were produced per week by two shifts of 15 girls each, and 95 per cent of these gages were passed on the first test. Besides this, the process received the commendation of the National Physical Laboratory of Great Britain.

Gashing Thread Gage Blanks Preparatory to Grinding

Before grinding, the gage blanks are roughly gashed out by thread milling. This operation is performed on a 7-inch tool-room lathe, equipped as illustrated in Fig. 1. A worm-wheel *A* is placed on the largest step of the cone pulley. Meshing with the teeth of this worm-wheel is a worm *B*

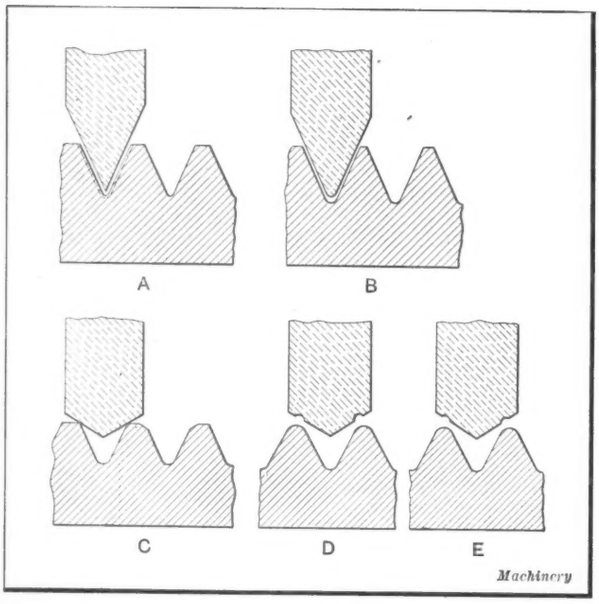


Fig. 3. Diagrammatic Representation of the Formation of Roots and Crests with the Corresponding Development of Curvature in the Wheel

that is held in engagement by a weight attached to one end of its supporting shaft. The worm sleeve terminates in a bevel pinion *C* which engages with another bevel gear on the horizontal shaft. The latter passes through a bracket on the top slide and supports a spur pinion on one end of the slide which drives the cutter-spindle through an idler gear. Traverse of the cutter is obtained by the ordinary saddle movement, through the lead-screw, change-gears, and cone pulley. The lathe is driven by the pulley *P* and the mechanism described. This attachment can be quickly removed from the machine, thus readily adapting it for the performance of ordinary work.

In the preliminary thread milling operation, the gage is machined to very nearly the correct root and pitch diameters, or to within, say, 0.010 inch on a 2-inch gage, while the outside diameter is left the same amount greater than the finished size. The gage thus prepared is carburized and hardened by quenching at a full cherry red heat.

Machine Used for Grinding Operations

The machine designed by Mr. Jones for grinding threads by this process was built by Drummond Bros., Ltd., Guildford, Surrey, England, and is illustrated in Fig. 4. The general features of this machine are similar to those of that class of grinding machines in which the wheel-head and its slide are held stationary while the work-head and tailstock are mounted on a slide which traverses to and fro past the wheel. As the grinding wheel must pass through the entire thread of the gage, the rotation and traverse of the work must be in correct relationship with the pitch of the thread being ground. To effect this, the lead-screw principle was adopted but without the use of change-gears, which means that a special lead-screw is required for each pitch to be ground.

This screw, the end of which is seen at *S*, is of sufficient length to provide the necessary travel for the work to be ground, which is about 3½ inches. It is mounted in a direct line with the work axis, thus giving direct control and obviating errors resulting from uneven feeding due to twisting stresses on the slides. A buttress thread is cut on this master screw because the force to be resisted from the tailstock always acts in the same direction. The screw is connected with the front work-spindle which runs in a bearing in the headstock. The driving mechanism of the screw consists of a cross-shaft driven by open and crossed belts through the pulleys *P* and their clutches. A worm is mounted on the cross-shaft which meshes with a worm-wheel on the spindle. Flywheel *F*, which is mounted on the front end of the cross-shaft, is provided for overcoming the inertia of the reverse movement of the machine. This reversal is obtained through the levers *L*, which are connected by rods and a cross-member to an extension of the spindle, so that at the termination of the traverse, the forward and reverse clutches of the pulleys *P* are alternately operated through the shaft *Q* and its connections. It will be seen that by these means the work is traversed past the wheel and back again, thus permitting grinding during both travels. Spring pressure was first adopted to hold the tailstock center up to the work, but it was found subsequently that in view of the special need for accuracy in replacing the work correctly, after it had been removed for testing, greater constancy was obtained by employing a gravity arrangement consisting of a weight and a series of pulleys.

The compound rest *R* is stationary during the operation of the machine, as previously mentioned, and carries the wheel-head on its top slide. Adjustment of the cross-feed is obtained by means of a screw of fine pitch and a graduated dial. The wheel-spindle is mounted in three-point ball bearings specially designed to eliminate vibration and end play. The wheel is roughly adjusted lengthwise to position by the lever *H*, which operates the supporting slide *A* through a rack and pinion. After the slide has been roughly located, it is locked in place by the handle *J*. Fine adjustment of the wheel lengthwise is obtained by a movement of the lower slide of the compound rest through a screw and handwheel *B*. No special provision has been made in the rest for setting the wheel over to the helix angle of the thread, as it is one of the peculiarities of this method of grinding that a very slight set-over suffices to secure the elimination of the differences in the respective flanks being ground, which show up if no such adjustment is made. The required set-over is secured by using different thicknesses of packing inserted under one end of the lower slide.

The grinding wheel that was used on a gage having 14 threads per inch was a Norton 6-inch, 80-grit, 2½-grade, elastic type, which ran at the rate of 4000 revolutions per minute. The grade of the wheel employed depends to a considerable extent on the pitch of the thread; because, while a soft wheel is suitable for a coarse pitch, a fine hard wheel should be used for a fine pitch. The wheel is sup-

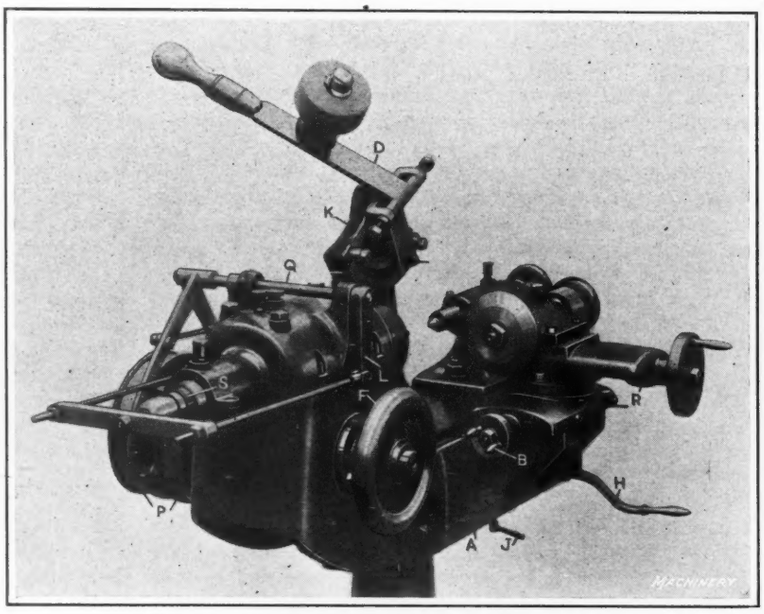


Fig. 4. Grinding Machine used for grinding Plug Gages

ported by a pair of aluminum clamp washers, 3½ inches in diameter. As the wheel is subjected to side thrust, it was necessary to extend the support of these flanges to as near the edge of the wheel as possible, their diameter being determined by trial. It was found that if the diameters of these flanges were too small, considerable variation in the thread angle resulted, due to wheel flexure. The periphery of the wheel is dressed to the required angle by means of a dresser which is mounted on the arm *D*. Excellent results are obtained by this simple arrangement, as it allows the wheel to be dressed to a fine edge without chipping. The arm is held between centers on a quadrant bracket *K*, about which it can be swung to within the limits imposed by stops which are set to produce the required angle on the edge of the wheel. Very little practice is required to enable the operator to handle this dressing attachment capably, and it takes only a few minutes to secure the requisite truth of angle and fineness of edge.

Microscopic Examination During Grinding Operation

A V-edged grinding wheel, as shown at *A* in Fig. 3, which is dressed to the correct angle for the flanks of the thread, is used for the first grinding operation. A selected number of gages—for example, ten—should be ground in succession, applying the same number of cuts to each member of the series before proceeding to the next. The grinding throughout is dry and is conducted in two operations, each on a separate machine. In the first operation, the milled thread is corrected to the required limits in respect to five elements, namely, root form, root diameter, pitch, angle, and pitch diameter. After a few traverses of the wheel, the work is taken out, and the operator tests the progress of the grinding by using a microscope for the general observation of the form of the thread, for checking the root form, errors in angle and straightness of the flanks, and for detecting the existence of local inequalities. In this microscopic apparatus, the gage is held between centers mounted so that by means of screws of fine pitch the gage can be moved in two directions at right angles to the axis of the microscope. A small filament lamp is arranged to project a beam of light along the helix angle of the thread, then the gage is adjusted and the microscope focussed until an image of the profile of an axial section of the screw is obtained. Stretched across the eye-piece of the instrument is a cross-wire, and secured at right angles to the eye-piece is a pointer which moves over a metal scale furnished with adjustable stops which, when set, limit the travel of the pointer. The use of the pointer renders the matter of observation simple.

A standard reference bar, having a V-groove, which has been previously tested and approved by the National Physical Laboratory, is inserted in the apparatus, and the pointer is adjusted until the wire coincides with one flank as shown by wire *O* at *A* in Fig. 5. One stop on the eye-piece is then set to the pointer when in this position, after which the pointer is turned until a similar coincidence is obtained between the cross-wire *P* and the opposite flank, when the second stop is set in this position. After the stops are set, it is a simple matter to place the gage in position and test for coincidence of the cross-wires and flanks. The result shown by the wires *R* and *S* at *B* would probably be obtained by such a trial after the wheel had been traversed once or twice across the roughed-out gage, whereupon the grinding would be proceeded with until a step further toward coincidence of flank and wire was obtained, as shown by wires *T* and *U* at *C*.

The process of wheel-truing is resorted to when the relation between the root and pitch diameters is out of proportion. If the root diameter is too great, a keen edge must be produced on the wheel, while a high pitch diameter is corrected by moving the slide laterally, which causes the wheel to remove material as indicated by the dotted line shown at *A* in Fig. 3.

Testing Pitch and Root Diameters

After reaching the stage shown at *C*, Fig. 5, the gage is tested for pitch and root diameters by means of a measuring apparatus of the type shown in Fig. 2. The gage is held between adjustable centers that are clamped in V-grooves in the uprights. Two other V-grooves are machined in the base to accommodate a sliding saddle, the latter being guided by short cylinders which slide in the grooves. On the top of the saddle is another pair of V-grooves in which run steel balls that support a carriage on which a micrometer is mounted. A graduated dial is fixed on the carriage, and the micrometer thimble carries a pointer. The graduations on the dial correspond to the required readings of the micrometer, so that the amount of excess metal to be removed in order to obtain a true pitch or root diameter is easily ascertained. The needles and vees used for obtaining the measurements are suspended by chains as indicated. Every thread in the gage is successively examined and the grinding operation repeated until the size is within 0.0005 inch, when a final touch of the wheel across the gage generally suffices to give the required dimensions. The sequence in which the series of gages is subjected to the finishing operation by the wheel when worn to its required shape is that in which the gages were operated upon in the preliminary grinding process whereby the wheel became worn. The gage is finally ground on its outside surface to the correct outside diameter.

Thus it is apparent that general reliance is placed upon the standard reference bar and microscopic comparison to secure correctness of root form and pitch, a method which is at once accurate and capable of being put into use by unskilled operators. The same principle of stops and indicators applied to the subsequent testing of the root and pitch diameters renders this operation an almost equally simple matter and well within the capacity of girls who have received

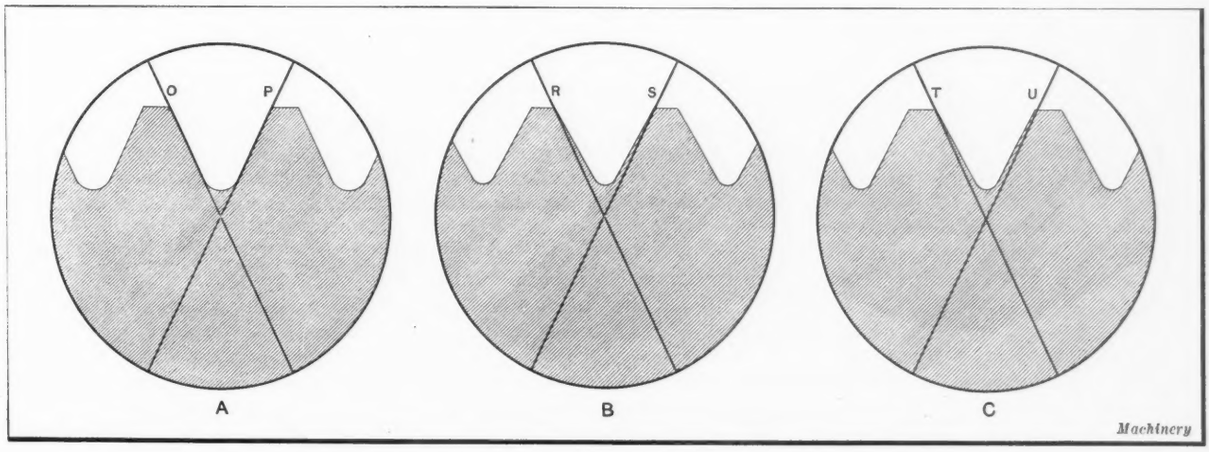


Fig. 5. Successive Stages of the Root and Flank Development as seen through a Microscope

no more than an elementary education. As previously stated, the first grinding operation secures the truth of five elements, namely, form of root, pitch, angle, and the root and pitch diameters. The rounding of the crests and the correct outside diameter are obtained by the second operation.

In this operation a series of gages is ground in succession, as was the case in the first operation. After the wheel has been traversed several times across the first gage, it is traversed a like number of times across each succeeding gage. Supposing the first gage to receive the correct contour were the last one in the series, then every other gage, beginning with the first one in the series, would be treated with the now worn wheel in the same order as formerly. As in the preceding case, inspecting by microscope with the use of a reference gage is resorted to from time to time, the outside diameter measurements being taken with a micrometer. The same method of truing is adopted as in the former instance, namely, a touch or two on alternate faces of the wheel with the dresser, which in this instance is arranged to swing through an angle of 85 degrees to suit the wheel.

* * *

MARKING PATTERNS TO PREVENT IMPROPER CORING

By M. E. DUGGAN

Core-prints on patterns are employed as a means of obtaining an impression in the mold to support the core. The core-print is made to the same sectional dimensions as the core desired if the latter is of a plain design, and so a molder selects a standard core of the same dimensions as the core-print when preparing the mold. When the core is of unusual design, a special core-box must be supplied for producing the core. Patterns having special core-boxes should be marked in such a manner that the molder will readily be made aware of the fact. The location of special cores is often indicated on the pattern by core-prints of the usual type, and unless the molder is notified in some manner, it is likely that a standard core of the same dimensions as the core-print will be placed in the mold instead of the special core desired. In such cases, the loss of the casting is the usual result. The following incident is an example of such an occurrence:

The pattern and core-boxes for a large printing press side frame were sent to a certain jobbing foundry for the production of the casting. This part was to have seven babbitted journals when completed, and a special core-box was required for molding the cores to be used in coring the openings for the babbitt. There was no information on the pattern to warn the molder of the necessity of using special cores, and the core-prints were of the ordinary type. The foreman also neglected to instruct the molder to use special cores, the result being that he selected standard cores of the

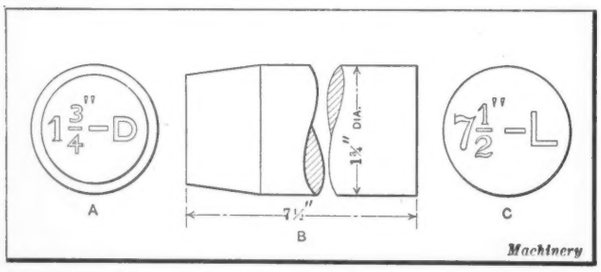


Fig. 1. (A and C) Markings on Core-prints indicating Dimensions of Core to be used. (B) Core furnished when Prints are marked as shown

same diameter as the core-prints on the pattern, and the casting was poured with the wrong cores in the mold.

In order to prevent errors of this sort, all patterns and core-boxes should be so marked that the molder can readily understand what is required. The writer installed the following system in a shop in which he was employed: The dimensions of the core to be placed in the mold are marked on the core-prints when a standard core is to be used, and if there are no dimensions on the core-prints, it indicates that special cores must be used. At *A* in Fig. 1 is shown the manner of marking the core-print on one end of the pattern, the dimension and letter indicating the diameter of the core. The marking for the print on the opposite end of the pattern is shown at *C*, the dimension and letter in this case indicating the length of the core. A drawing of the core which would naturally be selected by referring to the markings on the prints is shown at *B* in the same illustration. The markings on the core-prints eliminate the necessity of the molder measuring the prints when selecting the proper core. When a cored opening does not extend entirely through a pattern, so that a core-print is shown on only one side of

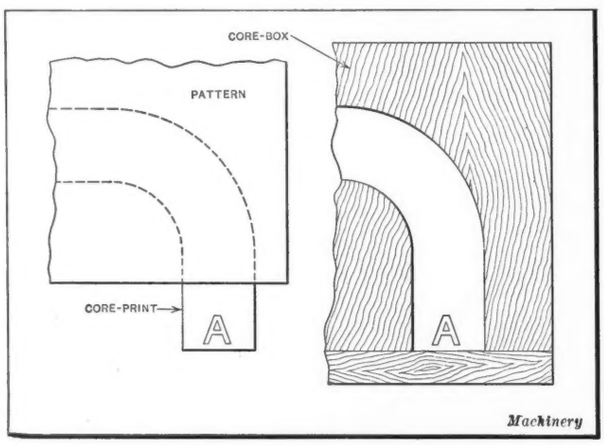


Fig. 2. Method of using Letters to identify Core and Core-box corresponding to any Particular Core-print

the pattern, both the length and diameter of the core are given on the same core-print.

When special core-boxes are required, the core-print and core-box are marked in such a manner that the core-box corresponding to any core-print can be easily determined. The method of identification is illustrated in Fig. 2, in which the core-print on the pattern is marked by a raised letter A. Another identical letter is similarly placed in both molds of the core-box, and after the core is molded and baked it will contain the impression of the letter on each half of the core. This system eliminates the danger of placing the improper core in any of the impressions left in the mold by the core-prints, and assists in the selection and matching of the core halves. Another advantage of marking core-prints and core-boxes is that the employes of the pattern storage loft are enabled to select readily the core-boxes that belong to a pattern, and no time is wasted in searching for special core-boxes when none are required for the part.

* * *

The statement of Dr. Van H. Manning, former director of the Bureau of Mines, in his letter of resignation to President Wilson, when he left the bureau to become director of research of the American Petroleum Institute, relating to the compensation paid to men in government service engaged in engineering and scientific work, deserves publicity. In leaving the government service Dr. Manning wrote:

"There has come to me today the thought that although this Government spends each year many millions of dollars in useful scientific work for the benefit of the whole people, the monetary recognition of its scientific and technical servants is not sufficient to enable them to continue in the service for the people. This has been especially true within the last few years when it has been impossible for many men to remain in the government service. With the marvelous expansion of industry in this country and the growing necessity of science to industry, the scientific bureaus have been utterly unable to hold their assistants against the competition of industry which is taking their highly trained men at salaries the Government does not pay or even approach."

The Problem of Overhead in the Repair Shop

By L. W. ALWYN-SCHMIDT

THERE are examples of well equipped repair shops which have started on a promising basis but which have come to grief because of their inability to show returns commensurate with the investment. In a great many cases, such failures may be traced to the fact that the owners have not given due consideration to the various factors entering into the cost of running their shops. The result is often that men who have started well, and who have had a good engineering education have scarcely been able to eke out more than a mere wage-earner's livelihood from the operation of their repair shop. Failure to make proper charges for services rendered is usually the cause, an example of which may be cited. A small machine shop located in a mixed agricultural and industrial district has been doing general repair work for a number of years. The owner has worked diligently to make his enterprise a success, but he has not prospered in the way he had expected. The capital invested in the plant is gone. If an estimate of his resources were made, this man would no doubt find that he had worked these fifteen years for less than he would have accumulated as a foreman, without the additional trouble and worry connected with a business.

The output of a machine tool shop has a definite selling value, whereas the work produced in a repair shop is more in the nature of selling service and therefore has no standard fixed rate. The cost of a repair job is usually set according to the customary local charge for similar work performed by competing establishments. Customers for whom repair work is being done do not as a rule prefer good work to cheapness, yet this condition is exactly reversed in the case of the purchaser of new tools. This tendency to keep the cost of making repairs down within the expectations of the customer has in many cases proved disastrous to those engaged in this line of business.

Usual Methods of Charging for Repair Work

The case cited is not a rare one and, like many others, is due to a lack of commercial knowledge. This lack of knowledge may be expressed as a failure to make provisions for overhead expenses. The usual method of charging for repair work is to compute the cost of labor and material, and add to the sum an additional 25 or 33 per cent. Another method is to find the sum of the cost of labor, plus 50 per cent of this cost, plus the cost of material. In either case, the additional percentage is expected to protect the owner against losses and to provide him with the necessary profits. It is rarely that the owner possesses a real knowledge of what the labor for each job costs and what charges must be included properly in the overhead. The fact that the proportion of the additional charge frequently varies, indicates that it is unsafe to base the charges for repair work upon either of these rules.

Suppose, in a shop in which six men are employed eight hours per day, that three are engaged on a job for a period of two days. The wage rate being 50 cents per hour, the cost of labor for the entire job would be $24. If 50 per cent of the cost of labor is added, the charge is increased to $36. During the time that these men have been at work on the job, they have made use of the facilities of the shop, they have occupied the building, have used one or more of the machine tools, and a proportionate charge should be made to cover all the overhead expenses such as advertising, taxes, the wages of the owner as manager, etc. Assume that the original cost of equipment is $30,000, the rent $800, and the general overhead $2000. It follows that the sum of these expenditures should be apportioned so that each job will bear its share, which in this case may be assumed at $17 per day. Now since only three of the six men employed in the factory are involved in this particular job, the overhead expenditure will be $8.50 per day or $17 for the entire job. Adding the wage rate of $24 to the overhead expenditure of $17 gives a total of $41, or $5 more than the $36 cost previously estimated.

In other words, the time plus percentage should be increased to equal $41 if the job is to share its proportion of the overhead burden. The case would be similar under any system where the overhead charge is made upon the basis of time and material. In the case cited, no provision has been made for the services of the owner, who is thus rated as giving his work, knowledge, and capital free of charge. This system is weak and should be replaced by one which is simple in application and which will give a more correct result for the cost estimate.

Suggested Method for Estimating Overhead Charges

The cost-plus-percentage rule is not very accurate in its results and is very likely to lead to considerable financial loss if it is used. The main trouble with the system is that not enough flexibility is allowed by the percentage scheme when determining the overhead expenditures. In a machine shop employing twelve men instead of six, as assumed in the example, the overhead cost per man is immediately affected. If, as in the previous assumption, the burden of overhead expense is apportioned at the rate of $8.50 for three men per day, or $2.83 per man, it would equal $1.41 per man, approximately, per day, if twelve men were employed instead of six. It follows that the overhead expenses per man and day decline with every additional man employed in the shop, provided the existing equipment is sufficient and that the employment of extra men does not require any additional expense.

In estimating costs, it is essential that they be based upon the actual proportions of overhead expenditure, determined upon by the time of each man on the job and not by employing an assumed rate, for such an assumption is very likely to be too low. To make a fairly close estimate of what the proportions of overhead expense should be is not a very difficult task. For the purpose of making an estimate, take as a basis the original investment and allow on this amount an interest charge which will insure an income equivalent to that which the money will bring if invested in any other stable business. If the investment is $30,000, as assumed previously in this article, at a rate of 5 per cent the interest charge would amount to $1500. Provision should be made for deterioration of the machine equipment and its maintenance, in the form of an 8 per cent allowance, taking into account the increased re-purchase value when making this estimate. For example, if the equipment was valued at $18,000 at the time of its purchase ten years ago, the present-day cost of the equipment can well be considered as $36,000. The deterioration charges should be based on this figure rather than on the original cost figure, which gives a charge of $2880. To these two items—interest on investment, and deterioration and maintenance of equipment—add such items as taxes or rent, as the case may be, advertising, salaries for salesmen, postage, light, power, and all other general expenditures. This amount should form the basis for the overhead factor which enters into the charge esti-

mate, and should not include labor cost, except that performed for maintenance and similar work; nor should it include the profit of the owner or the cost of material.

Reducing the Overhead by Increased Business

This established overhead affects the daily operation expense, and regardless of the number of men employed in the shop or the amount of work performed, should always be carefully estimated and should be increased from year to year with the higher cost of equipment or with the rising tax or rent rate. It is necessary that it should be checked annually and re-established in the manner just described. The important point to bear in mind is that the overhead expense is borne proportionately by the work performed by each man in the plant and that the more men employed, the smaller the allotment to each. If the overhead is $12,000, and if the number of working hours is 2400 per year, one working hour costs the establishment $5. If ten men are employed, the share of the overhead expense for each man's working hour is 50 cents; if twenty men are employed, the share is reduced to 25 cents. It is a simple matter to work out a standard overhead cost scheme giving the manager or owner the exact figure of how much should be added to the hourly rate of each man employed.

For a shop which normally employs ten men but which has a capacity of twenty men, one rate should be established for use when the payroll carries ten men, one when it carries more than ten but less than sixteen, and one when it carries sixteen or more. This should take care of all fluctuations in number of workmen, for in actual practice the variation in the monthly employment will rarely amount to 100 per cent. In a case where the share of overhead for each working hour is 25 cents, then a job taking three men sixteen hours, would cost an amount obtained by multiplying the entire number of hours used on the job, that is forty-eight, by 25 cents, or $12. To this should be added the wages of the men, the cost of material and, say, 15 per cent profit. Such a system would safeguard the repair shop against danger of failure and would eliminate the possibility of undercharging.

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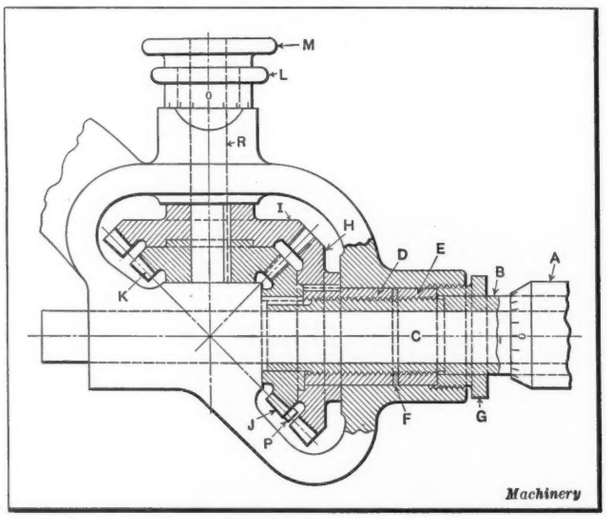
MICROMETER READING DIRECT TO A TEN-THOUSANDTH INCH

By M. JACKER

A micrometer head reading direct to 0.0001 inch, invented by the writer, is shown in the accompanying illustration. The graduated thimble *A* and spindle *C* are the same design as those of any micrometer of standard make. The ten-thousandth inch reading is obtained by a revolving threaded sleeve *B* which, by a sliding key connection with gear *J*, may be revolved by means of the differential gear train shown in the illustration. When the device is properly set, the micrometer can be used just as an ordinary micrometer is used when measuring to thousandths of an inch. When readings of 0.0001 inch are required, the micrometer is set to the nearest 0.001 in the usual way; then by turning the knurled nut *M*, the sleeve and the spindle which is set to the nearest 0.001 inch, is caused to move forward. The reading to 0.0001 inch can then be made direct from the graduations on the knurled collar *L*. Thus it will be seen that the device simply provides a means of advancing the spindle and its holder without disturbing the setting obtained by thimble *A* and sleeve *B*, and that the amount of this additional movement can be read directly in ten-thousandths inch. For instance, if it is required to set the micrometer to measure 1.9001 inches, the thimble on sleeve *B* is first set in the usual way to 1.9 inches; next the zero mark on friction sleeve *L* is set to the index line on the frame, and the knurled nut *M* turned just as if a reading were being taken by adjusting the thimble.

The spindle *C*, as previously stated, is made exactly the same as in the ordinary type of micrometer. The part *B* is also made the same except that instead of being fastened to the frame, it is feathered to the gear *J*, and provided with a threaded portion which screws into the two-part member composed of nuts *E* and *D*. The nut *D* is keyed to the gear *H*, and is separated from *E* by a corrugated spring washer *F* which is so designed that it will transmit motion from one nut to the other, and at the same time take up any lost motion which may result from worn threads. The nut *G* holds the threaded nut *E* in position, and also takes all the thrust from the measuring point. The knurled nut *M* is fastened to a shaft *R*, which, in turn, is keyed to the gears *I* and *K*. The friction collar *L*, on which the ten-thousandth graduations are marked, can be turned to read zero independently of the position occupied by the knurled nut.

Since there are forty right-hand threads to the inch on the lower end of the sleeve *B*, it follows from the way in which the differential gearing is arranged, that twenty-five revolutions of the knurled nut *M* will cause the gear *J* to make one less revolution than gear *H*. This action produces the same result as would be obtained by screwing *B* down one revolution when the two-part member and gear *H* are held stationary, which would cause the spindle and sleeve



Micrometer reading Direct to a Ten-thousandth Inch

to advance 0.025 inch. Thus one revolution of *M* causes the spindle to advance 0.001 inch, and one-tenth revolution advances the spindle 0.0001 inch.

In order to prevent the gears from making more revolutions than is necessary to obtain the required traverse of *B*, relative to the spindle frame, a lug is put on gear *J* at *P*, and two similar lugs are attached to gear *H* in such a position that gear *J* will be permitted to make only about one-eighth of a revolution in relation to gear *H*. This arrangement will permit a maximum travel of 0.003 inch to be transmitted to the spindle by rotating nut *M*, which is much more than would ordinarily be required.

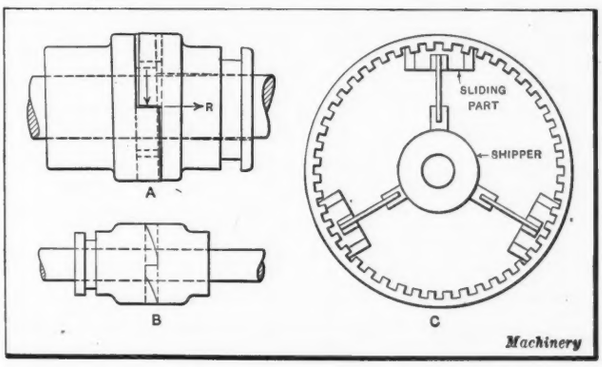
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The relative positions of Germany and France in regard to iron ore resources are at present as follows: Germany, about 1,270,000,000 tons, and France, 5,630,000,000 tons. It is estimated that the production of iron ore in Germany, excluding Luxemburg but including Alsace-Lorraine, during 1913 was 28,608,000 tons, and in France 21,918,000 tons. It is further estimated that at present it is possible for Germany to produce about 7,000,000 tons and that France should be able to produce about 43,000,000 tons, due to the recovery of Lorraine. The coal situation however, is somewhat different, as according to present indications, France will require 40,000,000 tons more than can be produced in her own mines, while on the other hand Germany has sufficient coal resources, but a limited supply of iron ore.

JAW CLUTCHES

By JOHN S. WATTS

The positive jaw clutch, when confined to its proper field and if well made, will perform its service effectively and with very little expense for upkeep. Unfortunately the advantage which may be gained by the use of the jaw clutch has in many instances been overlooked, and as a result it has been superseded to a considerable extent by more expensive types. However, for certain types of duty the positive jaw clutch is efficient, and owing to the simplicity of its design, should receive precedence over the more complicated types. The use of the positive clutch is limited by the fact that the shaft must either be stopped or must revolve very slowly when the clutch is being engaged, but after engagement it may be disengaged without trouble and when revolving at any speed. Although these facts are perhaps well known, it often happens that an expensive friction clutch, for instance, is installed where at much less expense the positive type could have been employed. The factor of expense concerns the installation as well as the upkeep costs. As an example of the type of work for which this clutch is particularly adapted, it may be stated that practically all the winches used on shipboard for unloading cargoes are



Various Types of Jaw Clutches. The Type shown at A illustrates the Effect of Wear on the Efficiency of the Clutch

equipped throughout with jaw clutches. The hoisting engines employed for this work are subjected to severe usage, and since the jaw clutch has proved successful for this particular work it is evident that it should be suitable for similar strenuous service.

The principal requirements for the successful operation of a jaw clutch are that the area of the faces of the jaws be sufficient to transmit the load; that the surfaces be machined so as to contact all over; and that the shaft be strong enough so as not to deflect under load and throw the clutch members out of alignment. If the jaws are not machined so as to give a true contact between the members of the clutch, the points of the jaws will wear and cause an axial thrust which will force the two members apart. This will develop, if allowed to continue, so that the clutch jaws cannot be kept in contact, since the leverage required on the shipper ring to counteract this thrust will be so great that the ring will become heated through friction. Perhaps the greatest difficulty experienced with this design of clutch is due to the fact that the teeth are not always machined, and as a result the load is concentrated on one jaw so that the sliding member is forced out of alignment, resulting in the jaw wearing away, as indicated in the accompanying illustration at *A*.

As this wear increases the axial force *R* also increases, the tendency being to force the sliding member out of contact, which eventually becomes so great as to destroy the usefulness of the clutch. The clutch will not wear itself down to a bearing surface, as might be supposed, for the tendency is for it to become more and more out of alignment, both on the jaws and in the fit on the shaft. Unless all the driving faces have an equal bearing, the sliding member of the clutch will twist out of line when under load and wear the jaws away still more from a plane parallel to the axis of the shaft. Even when the jaws are machined and are in contact, there is still the tendency, because of the projection of the jaws from the body of the casting, for the sliding member to be thrown out of alignment an amount determined by the degree of looseness of this part on the shaft. This is due to the turning moment having a certain amount of leverage. This tendency for the clutch to work out of alignment is cumulative. It is, in fact, upon this very point of machining the jaws so as to keep the two parts of the clutch in alignment, that the success of this type of clutch depends.

In order to prevent this tipping effect, the jaws should not project any more than is necessary to provide sufficient bearing area. The diameter may be made as large as desired. The shipper end member should be designed for two keys (except in clutches of the smallest sizes), which will practically eliminate this trouble and also will provide a greater surface area for resisting the wear which tends to throw the clutch out of alignment. Much less effort is required to operate the clutch when two keys are used.

The bearing pressure on the jaw faces should not exceed 2800 pounds per square inch for clutches which are engaged and disengaged when not subjected to load. If the clutch is to be operated while the shaft is in motion, the pressure should not exceed 700 pounds per square inch, as otherwise the contacting surfaces are liable to be abraded. The jaws should have a sufficient area of contact to prevent shearing. The shearing stress should not exceed 2100 pounds per square inch if the load is applied gradually, and not more than 1400 pounds per square inch in cases where there is any possibility of shock. The depth of the groove in the shipper ring should be governed by the amount of bearing surface that is necessary to carry sufficient pressure to throw the clutch into and out of engagement. The pressure on the bearing surface should not exceed 50 pounds per square inch.

When the clutch is not operated under load, the force required to move the sliding member is that due to the friction between this part and the shaft and keys, and is equal to the weight of the sliding member multiplied by the coefficient of friction, which will not be greater than 0.20. When the clutch is operated under load, it will be necessary to add to this product the friction between the jaws due to the load, which will equal the pressure on the jaws multiplied by 0.20. In establishing the diameter of the pin on the shipper ring, allowance should be made for the fact that as the clutch is operated usually by a hand-lever, there is always the possibility for an operator to exert a much greater pressure on the clutch than the above calculations provide for, or more than is necessary.

In the illustration there are shown three of the types of positive clutches in use, of which there are many variations. The type shown at *A* is used when the direction of rotation may be reversed, and contains a variable number of jaws, according to conditions. When the direction of rotation is not to be reversed, the type shown at *B* is commonly used, and this has the advantage of more easily engaging when rotating than the first type. The clutch shown at *C* is self-locking, and is intended for heavy loads, such as winding and hoisting engines, for which type of service it is particularly satisfactory.

* * *

Statistics published by the Canadian Government, covering foundries and machine shops in Canada during 1918, show that the country has 667 establishments in this industry with a total invested capital of over $84,000,000. Ontario is the leading province in this line, more than one-half of the number of plants and nearly two-thirds of the capital invested being represented by this state. Quebec follows with nearly one-fifth of the total number of plants in Canada and with nearly one-fifth of the total capital investment. Most of the remainder of the industry is located in British Columbia. The total value of the manufactured products was over $82,000,000, of which about one-tenth, or $8,000,000, represented machinery of various kinds.



Herringbone Gears for Machine Tools

Advantages Gained by the Use of Herringbone Gears, and Methods Employed in Cutting Them

By NIKOLA TRBOJEVICH, Designing Engineer, Illinois Tool Works, Chicago, Ill.

In this article the author discusses the advantages derived from the application of herringbone drive for transmitting motion uniformly, deals with the satisfactory cutting of one-piece gears, and compares spur and spiral gear action from the standpoint of pressure angles, tooth form and depth, lines of contact, wear, and smooth operation. The conclusion drawn from the author's treatment of the subject of specific pressure is that spiral gears should be calculated on the basis of specific pressure rather than by means of the Lewis formula. The use of single-threaded hobs is advocated, and a detailed examination of the factors entering into the selection of the tools for cutting the threads or teeth in hobs for producing gears is made.

IT has been found in the case of machine tools, especially those which employ comparatively long trains of gears or which are used for precision work, that spur gears can be advantageously replaced by spiral gears. The reason for this is that the action of spiral gears is considerably smoother and more free from vibration than that of spur gears. Mathematically, this feature would be explained in the following way:

A spur gear transmits motion uniformly from one shaft to the other by means of its tooth curve, while the spiral gear transmits the motion principally through the pitch helix, the other parts of the tooth curve being of secondary importance. This means, in the first case, that uniformity of motion depends on the accuracy of the tooth curve, while in the case of a spiral gear it is the accuracy of the pitch helix that counts. It is well known that it is much easier to produce a helix accurately than an involute curve according to the present machining methods. A helix is simply a product of a rotation and a translation, and almost any machine tool will produce it with accuracy, provided a few ordinary precautions are taken. The involute, on the other hand, is copied or generated from a gear-cutting tool, and extreme accuracy is difficult to obtain; the slightest deviation from the theoretical curve is magnified in its effect sufficiently to cause vibration and noise in the gearing. Actual measurements have shown that an error of only 0.0002 inch in the involute curve is detectable when the gears are run at a high velocity. Theoretically, if an absolutely correct curve could be produced on a spur gear, it would run just as smoothly as a "correct" spiral gear, but to attain this in practice is out of the question.

Wearing Qualities of Spiral Gears

An important advantage of the spiral gear over the spur gear lies in its wearing qualities. When a tooth curve rolls with its conjugate curve, there is a pure rolling action on the pitch line, on both spurs and spirals carried on parallel shafts. There is also a combined sliding and rolling action on the points situated above and below the pitch line. This sliding component increases very rapidly as the distance increases between the point of the tooth and the pitch line. The sliding or rubbing action causes the points on the tops and bottoms of the teeth to wear out much more rapidly than in the neighborhood of the pitch line. In fact, the points in the neighborhood of the pitch line will hardly wear at all, due to the pure rolling contact occurring there, which may be considered for all practical purposes as frictionless, provided, of course, that the teeth are correctly spaced. The consequence is, in the case of either spur or spiral gears, that after they have worn out, the pitch line stands out prominently and remains uninjured, while the other parts of the tooth curve are practically destroyed, at least for the purpose of contact. After the spur gears have been worn out to such a degree, they become practically useless, as they cannot transmit motion uniformly, due to the absence of the necessary tooth curves and consequently to the loss of continuity of contact. The motion is transmitted then, intermittently, mostly through shocks imparted by the points of the pitch line. The spiral gears, on the other hand, can be used even in such a worn-out condition, because the pitch helix usually remains intact throughout its entire length. If the face of a spiral gear is sufficiently wide to permit the overlapping of two consecutive teeth, the contact will always remain a smooth and continuous one. Of course, the unit pressure on the tooth surface will gradually increase as the teeth wear out, but if the load is not too great and if it does not crush the metal on the pitch line, such gears will function correctly for an almost indefinite time.

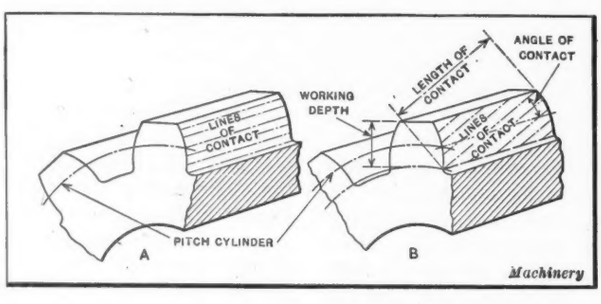


Fig. 1. Lines of Contact on Spur and Spiral Gears compared

Width of Spiral and Herringbone Gears

The minimum width of face should be such that the amount of overlap between two consecutive teeth will equal the product of the circular pitch and the cotangent of the helix angle. For the customary helix angle of 23

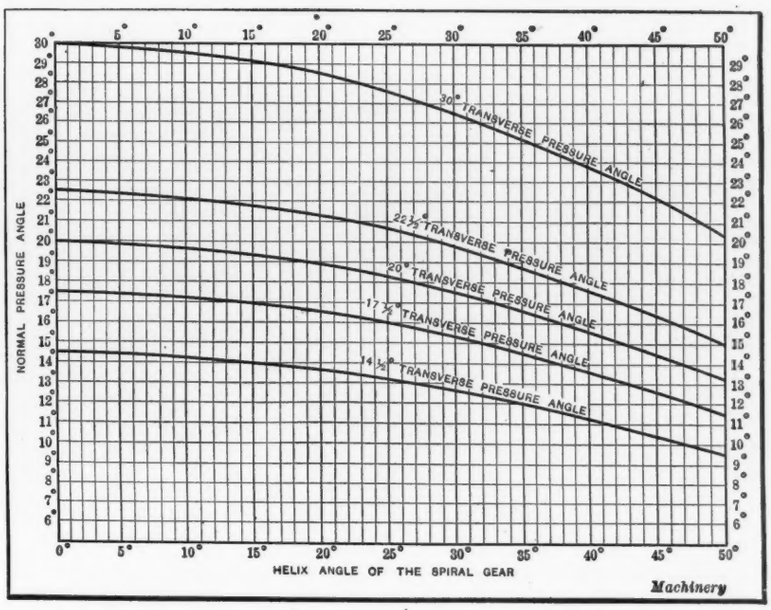


Fig. 2. Relation between the Normal and the Transverse Pressure Angles of a Spiral Gear

degrees, the minimum width on each side should be about 2½ times the circular pitch, this width being about 6 per cent greater than the theoretical minimum. Thus, a herringbone gear should have a total minimum width of 2½ times the circular pitch on each side of the central clearance space, plus from about 1 to 1½ times the pitch for width of groove or clearance space between the right- and left-hand sections. This gives a total width of from 6 to 6½ times the circular pitch for a one-piece herringbone gear.

Compound and One-piece Herringbone Gears

The custom is to make at least one gear in a herringbone drive of two sections, that is, two spiral gears fastened together. It is sometimes claimed that one-piece gears cannot be cut with sufficient accuracy to produce an even bearing in both sections of the gear. It is believed, however, that one-piece gears, both for driver and driven, can be made satisfactorily if the following points are observed.

(1) The right-hand section should be cut with a right-hand hob, and the left-hand section with a left-hand hob.

(2) Both hobs should be of the same make and tooth form and of very nearly the same diameter. The diameters of hobs should be held within 1/64 inch of each other.

(3) The angle of helix should be as accurate as possible. If the ratio of the two gears is 1 to 1, the same train of gears should be used on the hobbing machine, both for index and for feed, when cutting both sections of the teeth in each half of the gear. Under such conditions a slight error in the change-gear ratio is permissible, because the helix angle will then be uniformly affected throughout and the error will be fully compensated for.

(4) It is essential that pitch diameters be held the same on both sections within very close limits.

It is not necessary in the two-piece construction that the relative positions of the right- and left-hand helixes be very strictly kept. If the helixes are not exactly aligned on two herringbone gears, one of the gears can always be shifted lengthwise on the shaft to a position where they will align. For every 0.001 inch error in the helix alignment, the gear should be shifted lengthwise about 0.0025 inch.

Pressure Angle and Tooth Form

If the herringbone gears are hobbed and do not have to interchange with shaped gears, the matter of pressure angle is of little consequence. Under normal conditions about 20 degrees pressure angle gives satisfactory results, although one prominent concern is using 16½ degrees. The writer knows of a case in which 10 degrees normal pressure angle was used, producing a remarkably silent drive, although considerable rubbing action occurred at the tops and roots of the teeth. Although it seems to contradict the theory, it has been repeatedly observed in practice that while, in general, gears that have high pressure angles are more efficient and run more smoothly, they produce more noise than gears with low pressure angles. Thus, the absence of noise is not necessarily a proof of high mechanical efficiency.

Depth of Teeth

The whole depth of herringbone gear teeth should not be quite as great as on spur gears. The principal difference between the spur and spiral gear systems has already been pointed out, for the purpose of showing that the main advantage of the spiral gear system over the spur gear system lies in its correctly formed helix at the pitch line and vicinity.

The present practice regarding depth of tooth is to use about 0.8 of the standard depth. In the opinion of the writer, even that is too much, and it is also believed that herringbone teeth will soon be made to closely resemble helical splines. It should be borne in mind that a deep form weakens the tooth materially. When the strength of a gear tooth is figured, the entire tangential load is assumed to be concentrated on the top of a single tooth, so that if breakage results it will occur at the root of the tooth. Hence, to increase the depth means to increase the leverage of the load, and vice versa. The increase of pressure angle also strengthens the tooth, as the root of a 20-degree pressure angle tooth is, of course, thicker than that of a 14½-degree tooth, for instance.

It is sometimes necessary to know the relation between the normal pressure angle and the transverse pressure angle of a spiral gear. A case of that kind arises when it is desired to find the pressure angle of a hob which would interchange with a helical gear-shaper cutter. These cutters are usually made to an even transverse pressure angle (that is, the pressure angle relative to the section perpendicular to the gear shaft), while the hob is made to correspond to the normal pressure angle of the gear. The geometrical relation

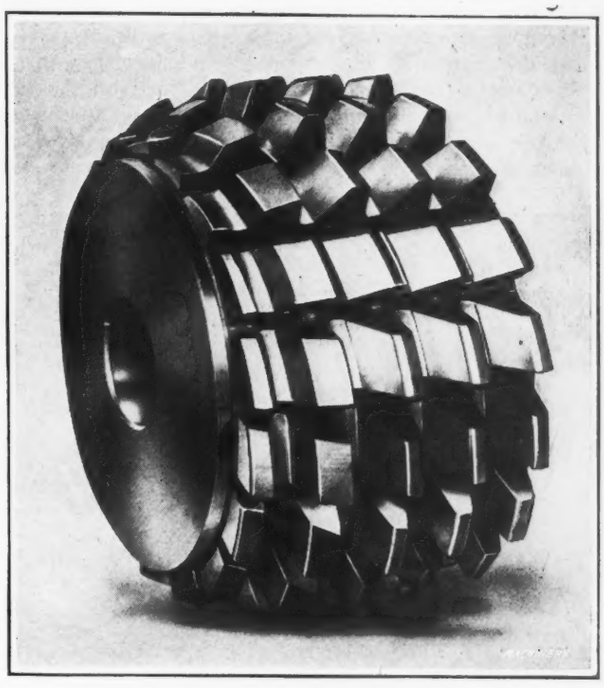


Fig. 3. Single-thread Herringbone Gear Hob

which exists between the two pressure angles may be expressed as follows: *The tangent of normal pressure angle equals the tangent of transverse pressure angle multiplied by the cosine of helix angle.* On the chart, Fig. 2, the curves representing various transverse pressure angles have been plotted from this formula. It will be noted that for small helix angles the two pressure angles are of practically the same magnitude.

The Specific Pressure

From the point of view of specific pressure, spiral gears are at a disadvantage as compared with spur gears. On spur gears the line of contact is equal in length to the width of the gear, and runs parallel to its axis as at *A* in Fig. 1. On involute spiral gears the tooth surfaces are involute helicoids, that is, ruled and developable surfaces, on which the generating straight line forms a constant angle with the pitch helix, as Figs. 5 and 6 show. The angle which the generator includes with the pitch helix depends on both the helix angle and on the pressure angle of the gear. In a representative case, for a 23-degree helix angle and a 20-degree normal pressure angle, that angle is approximately 30 degrees. That the contact is along the generators can best be seen from the paper model illustration, Fig. 5. When the surfaces are rotated at the required ratio of velocities, the corresponding generators on the two helicoids will successively cover one another along their entire length. Hence, the length of contact between the two engaging teeth of a helical drive (see *B* Fig. 1) will be approximately equal to the continued product of the cosecant of the angle formed by the generators and the pitch helix, the working depth of the tooth, and the secant of the normal pressure angle. If we assume that the depth of herringbone gears is equal to about 0.8 of the standard depth for spur gears, the total length of contact of the drive in question will be cosec 30 degrees $\times$ 0.8 $\times$ 0.637 circular pitch $\times$ sec 20 degrees $=$ 1.08 circular pitch.

This length of contact would be realized if the teeth were of a true involute shape from top to bottom. In practice, it is safer to estimate that length, however, to be exactly equal to the circular pitch. Hence, a spiral gear having a width of 2½ times the circular pitch has, roughly, only about 40 per cent of the length of contact which a spur gear of similar dimensions has. There are, however, two more important factors which should be considered when comparing the helical with the straight-tooth type.

First, there is the curvature of the surfaces. On spiral gears the radius of curvature is much longer than in the case of similar spur gears, and the tooth surface lies nearer to its tangent plane. This, naturally, will reduce the surface pressure, owing to the elasticity of the metal employed. A similar phenomenon to that found on bevel gears exists, due

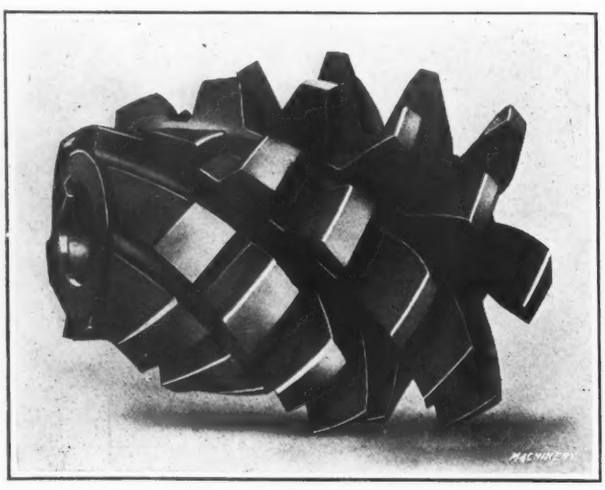


Fig. 4. Multiple-thread Hob for cutting Spiral Gears

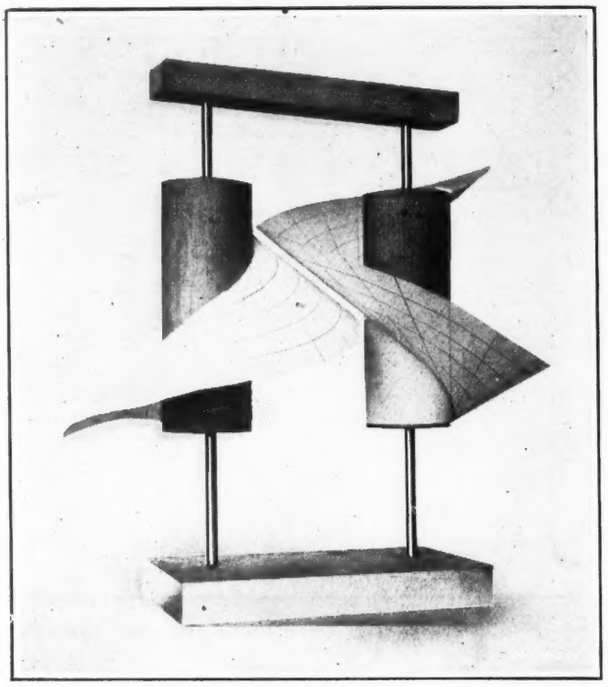


Fig. 5. Paper Model illustrating Action of Involute Spiral Gearing when the Shafts are Parallel

to the increased radius of curvature of the normal sections of teeth; the gears appear to have, so far as their rolling qualities are concerned, a greater number of teeth than is actually the case. This "ideal" or equivalent number of threads or teeth, so called, is on spiral gears equal to the original number of threads multiplied by the third power of the secant of the helix angle. For 23 degrees this increase equals 28 per cent.

The other factor to be considered is that there is generally less friction in a spiral gear than in a spur gear of similar dimensions. This is due to the fact that the spiral gears, as a rule, are shallower and have a greater transverse pressure angle. The friction is further reduced and the mechanical efficiency of the drive increased because, owing to the helical action, the vibration is practically eliminated.

As previously shown, the specific pressure is about 2½ times greater on spiral than on spur gears for the same load. However, even this increased pressure is not sufficient to offset the advantages of the spiral type in other respects, such as freedom from vibration and excessive friction. One of the most efficient mechanisms in use is the ball bearing, in which the surface pressures are enormous. If, in a mechanism, the material has sufficient tensile strength, a great surface pressure in itself is not a very objectionable feature. It is much more important that friction be avoided even under a moderate pressure, as a combination of excessive pressure and friction is detrimental to any machine part. From this point of view herringbone gears can stand any comparison with spur gears, especially if the depth of tooth of the former be still further reduced.

Hobs for Cutting Herringbone Gears

The hobbing method is well adapted for cutting spiral and herringbone gears. It has been shown that the main strength of that type of gearing lies, first, in the correctly formed pitch helixes and adjacent parts of the tooth surface, and principally, in the correct spacing of the teeth. There is no other known method of gear cutting in which indexing and its attendant errors are so completely eliminated as in hobbing gears with single-threaded hobs; for errors of indexing can only be completely eliminated when the gear-cutting machine operates on a continuous or generating principle, and the cutting tool itself is also made on that principle. A multiple-threaded hob, or a gear-shaper cutter, however, consists of a

number of independent threads or teeth which cannot be manufactured without using some sort of indexing apparatus.

The elimination of this difficulty is a very important point in favor of single-threaded hobs. In fact, this property of single-threaded hobs is being rapidly recognized and taken advantage of by engineers, when trying to cut gears having the greatest possible accuracy.

The cutting of herringbone gears with multiple-threaded or Wuest hobs has been advocated by many, and there is no doubt that the method possesses some advantages. On Wuest hobs the number of threads and the diameter of hob are selected so that the thread angle is the same as the helix angle of the gear to be cut. This feature permits of placing the hobs horizontally on the hobbing machine, in a perpendicular position with respect to the shaft of the gear. The fact that formed hobs are now made to produce ordinary spur gears without the need of tilting the head of the hobbing machines (Zimmermann's "right-angle" hobs), is an indication that of which is equal to the base radius of the transverse lamina of the spiral gear. The lead and the hand of the base helix are the same as those of the gear.

The Involute Hob

A hob is merely a spiral gear provided with suitable cutting edges. In order that a hob may produce correct involute spiral gears (or spur gears), it must be a correct involute spiral gear itself. Hobs are generally made with perfectly straight cutting edges on the normal section. This is not quite correct, theoretically, but for single-thread hobs, the error is practically negligible. The error, however, rapidly increases as the number of threads, or what amounts to the same thing, the angle of thread is increased; for the normal tooth curve of a spiral gear is approximately the same as that of a spur gear having as many teeth as the "ideal" number of teeth in a hob of a spiral gear. On the other hand, the ideal number of teeth is equal to the cosecant

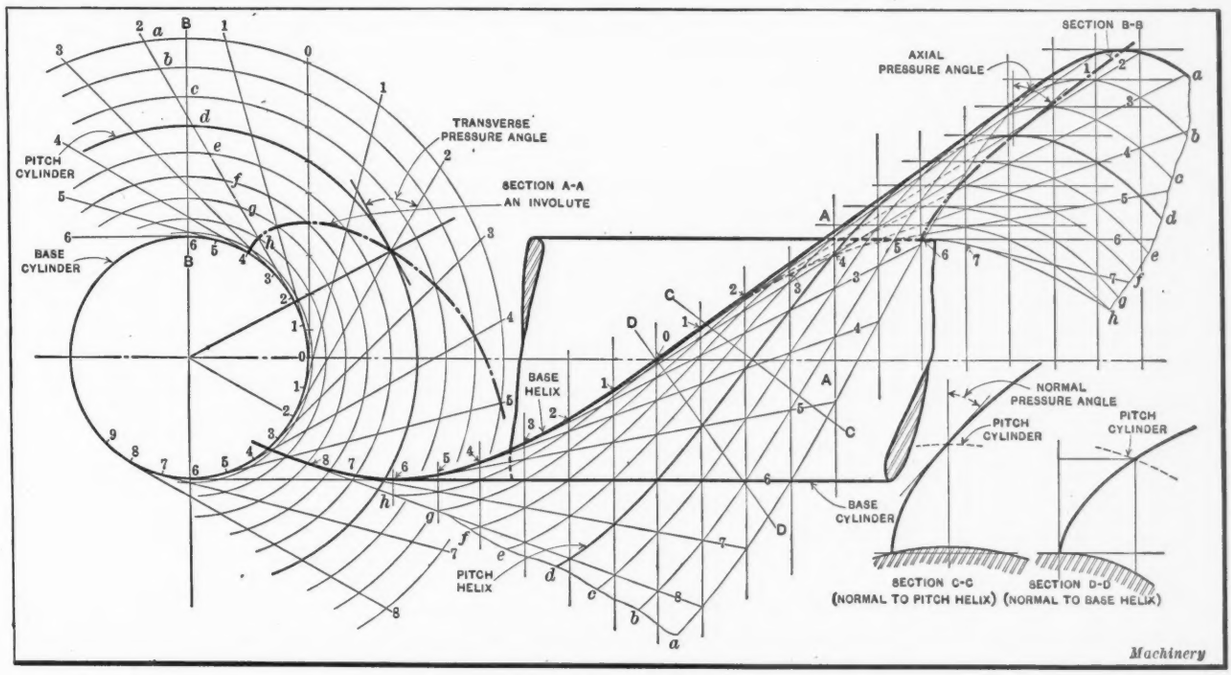


Fig. 6. Involute Helical Surface and its Principal Sections

both spur and spiral gears can be hobbed without swiveling the head of the machine. In addition to this, the Wuest hobs, owing to their horizontal position while cutting, require a slightly narrower clearance space between the right- and left-hand gear sections. The "over-travel" is also less than for single-thread hobs.

In spite of all these apparently important advantages, the writer is strongly in favor of single-threaded hobs, ground in the thread after hardening. In order that this point of view may be more clearly seen, we shall review in what follows a few of the principles of the theory of hobbing involute spiral gears.

Principles of Hobbing Spiral Gears

The involute tooth surface can be produced by uniformly twisting a spur gear. In the course of this transformation the straight line generators of the spur gear become helixes while the involutes remain unchanged. Hence, a correct spiral tooth surface has only one section which is involute, and that is the transverse (perpendicular to the shaft) section. It can be shown by actual calculation (see page 429, January, 1919, MACHINERY) that the involute surface can also be swept by a straight line rolling on a helix. The spiral involute surface is a ruled and developable surface, in which the straight line elements are so arranged as to be always tangent to a helix, the so-called base helix (see Figs. 5 and 6). This base helix is wound on the base cylinder, the radius cubed of the thread angle, multiplied by the number of threads or teeth. The term "thread angle" is used here to denote the angle of hob helix with a plane perpendicular to the hob axis, and is therefore complementary to the gear helix angle. The smaller the thread angle, the greater the ideal number of teeth will become, because the cosecant increases with the decrease in magnitude of the angle. For example, a single-thread hob of 4 pitch and 3.845 inches pitch diameter, having a thread angle of 3 degrees 43 minutes, has an ideal number of teeth of 3652, because the cosecant of that angle is 15.4 and its cube is 3652. Evidently a spur gear having 3652 teeth would be practically a rack, and its tooth outline would be straight lines, in the involute system of gearing. In this case the actual error in normal tooth curve for a 14½-degree pressure angle is less than 0.0003 inch, whereas a hob of the same normal pitch and diameter, having six threads and a thread angle of 23 degrees, has an ideal number of teeth of 101, and a corresponding error of nearly 0.01 inch. This is a thirty-six fold increase in error, and in order to maintain the involute system, the cutting edges of the hob would be pronounced curves, the exact equation for which cannot be arrived at except by very complicated calculation. The ideal number of teeth is the index number showing how closely a hob approximates a rack.

In principle, the use of multiple-threaded hobs for cutting spiral gears is correct; but with the present development

in machining methods it is almost impossible to produce sufficiently accurate multiple-threaded hobs. The relieving of the teeth, and the problem of indexing the threads may be considered as even greater obstacles to the accuracy than the development of the correct tooth form itself. For instance, the tool with which the teeth of the multiple-threaded hobs are cut and relieved must be ground in a special fixture so that its top surface will be warped in approximately the same way as the gash of the hob is warped, as otherwise the cutting edges cannot be correctly relieved. For the same reason, flat gages cannot be used for inspecting such hobs. All tooth caliper dimensions must be corrected to allow for the curvature of different helixes and helicoids. When changing from one thread to the other on the relieving lathe, both the main spindle and the camshaft must be indexed. The indexing of the cam which governs the radial motion of the relieving tool is especially troublesome, as the angle to be indexed is a function of such quantities as lead of thread, lead of gash, number of threads, and number of gashes—that is, an irrational quantity. In the majority of cases the accuracy obtained, in spite of greatest efforts, is inadequate for the purpose, and hardly comparable with the accuracy usually found in ordinary commercial single-threaded hobs.

TABLE 1. INCREASE OF THREAD ANGLE ON 4-PITCH HOBS, AFTER ¼-INCH REDUCTION CAUSED BY REPEATED GRINDING

Number of Threads	Pitch Diameter of Hob, Inches		Thread Angle of Hob, Degrees and Minutes		
	Original	After Grinding	Original	After Grinding	Increase
1	3.845	3.595	3–43	3–58	0–15
2	3.845	3.595	7–28	7–59	0–31
3	3.845	3.595	10–27	11–9	0–42
4	3.845	3.595	15–4	16–4	1–0
5	3.845	3.595	18–58	20–11	1–13
6	3.845	3.595	23–0	24–25	1–25

Machinery

Thread Angle and Normal Pitch as Functions of Diameter

The thread angle of a hob changes when the diameter of the hob is reduced. This, of course, affects the accuracy, because the diameter must be reduced through repeated sharpening. Now, the error from this source is practically infinitesimal for hobs having a small thread angle, but it becomes quite noticeable and even prohibitive for large angles, which of course, means for multiple-threaded hobs. The rate at which the error increases for various thread angles, and the amount of error can readily be determined. In the following equations,

l = lead of hob;
α = thread angle;
D = pitch diameter of hob;
p = normal circular pitch;
n = number of threads.

$$\text{Tan } \alpha = \frac{l}{D\pi} \qquad (1)$$

Therefore

$$D = \frac{l}{\pi} \text{ cotan } \alpha$$

But

$$l = \frac{np}{\cos \alpha} \qquad (2)$$

For a given hob the lead remains constant while the diameter of hob is being reduced through repeated sharpening. Hence, in Equation, (1) α and D are the variables. Differentiating with respect to D, the rate of variation is found, thus:

$$dD = -\frac{l}{\pi} \times \frac{d\alpha}{\sin^2 \alpha}$$

or

$$d\alpha = -\frac{\pi}{l} \sin^2 \alpha \, dD \qquad (3)$$

That is, the error increases with the square of the sine of the thread angle.

Table 1 shows the change in thread angle on 4-pitch hobs, having one to six threads, 4 7/16 inches outside diameter, when the diameters of hobs are reduced ¼ inch through repeated sharpening. The resulting change of the thread angle is about six times greater for a six-thread, than it is for a single-thread hob.

The variation of the diameter also affects the length of the normal circular pitch of the hob. This follows from the fact that the normal circular pitch is a function of the lead, the diameter, and the number of threads of the hob. On a certain hob, the number of threads and the lead are necessarily constant, while the diameter is gradually reduced through repeated sharpening, as already stated. This error, while not nearly as serious on hobs as it is, for instance, on gear-shaper cutters, may amount to considerable inaccuracy on multiple-threaded hobs. From Equation (2)

$$p = \frac{l}{n} \cos \alpha \qquad (4)$$

and

$$\text{Tan } \alpha = \frac{l}{D\pi} \qquad (5)$$

Differentiating Equations (4) and (5) with respect to p, D and α, and considering the last-named variable as a parameter:

$$\frac{dp}{dD} = -\frac{l}{n} \sin \alpha \frac{d\alpha}{dD}$$

$$\frac{d\alpha}{dD} = -\frac{\pi}{l} \sin^2 \alpha$$

After eliminating the derivative of α with respect to D from the above system, we have

$$dp = \frac{\pi}{n} \sin^3 \alpha \, dD \qquad (6)$$

Equation (6) shows that the length of the normal pitch of a given hob decreases with the third power of the sine of the original thread angle, when the diameter is decreased. It is interesting to note that Formulas (1) to (6) also apply to gear-shaper cutters, as a helical gear-shaper cutter is essentially a multiple-threaded hob of, for example, 67 degrees thread angle, used for cutting 23-degree helix angle gears; while a spur-gear-shaper cutter is equivalent to a multiple-threaded hob of 90 degrees thread angle and an infinite lead. Table 2 compares the single-thread hob, the six-thread hob and the helical-gear-shaper cutter, as regards the change in

TABLE 2. CHANGE IN THREAD ANGLE AND PITCH OF GEARS WHEN DIAMETER OF CUTTING TOOLS IS REDUCED BY GRINDING

Name of Cutter	Diametral Pitch	Number of Threads	Pitch Diameter, Inches		Thread Angle Increase, Degrees and Minutes			Normal Circular Pitch Decrease, Inches		
			Before	After	From	To	Increase	From	To	Decrease
Single Thread...	4	1	3.845	3.720	3–43	3–51	0–8	0.7854	0.7852	0.0002
Six Threads.....	4	6	3.845	3.720	23–0	23–46	0–46	0.7854	0.7813	0.0041
Helical Gear Shaper.....	4	14	3.845	3.675	67–0	72–15	5–15	0.7854	0.7682	0.0172

Machinery

their respective thread angles and normal circular pitches when the diameter is reduced by repeated sharpening. It will be seen that the tabulated diameters and amounts of reduction for each are such as to permit comparisons to be readily made. These comparisons show the amount of superiority of the single-thread hob over the other two gear generating tools, so far as keeping the correct tooth form after sharpening is concerned.

The angular and pitch errors of the cutting tools are not, however, transmitted to the helix angle and the lead of the spiral gears, as one might think at first glance, because these elements are determined by the way the hobbing or gear-shaping machine is geared or set up, and not by the shape of the cutting tool. The errors in thread angle and pitch of the cutting tool will show themselves in the changed form, pressure angle, and thickness of teeth of the spiral gear. Thus, gears cut by a worn-out hob or by a gear-shaper cutter will not, strictly speaking, be the same as those cut by a new cutter. For single-thread hobs, however, the error from this source is hardly detectable, even for the finest class of work.

Conclusions

From the above observations we may draw the following conclusions:

(1) If silent operation is required, spiral gears are more likely to possess that feature than spur gears.

(2) The specific pressure on spiral gears is greater than on spur gears. For this reason spiral gears should be calculated on the basis of specific pressure rather than according to the commonly used Lewis formula for strength of gear teeth.

(3) On spiral gears, all features which decrease the friction as a rule increase the specific pressures. The pressure angle and the helix angle are somehow related as common agents in reducing the friction and increasing the surface pressure. When either of them is increased, the friction is reduced, but at the same time the line of contact is shortened. However, the pressure and helix angles distribute the pressure in a different manner. A great pressure angle has a tendency to throw the load toward the journal, while a great helix angle will divert that load mainly in the axial direction.

(4) The logical tool to cut herringbone gears is the single-thread hob, for the following reasons: First, it has a straight-line cutting edge for the involute system of gearing; second, it can be made accurately and can be ground in the thread after hardening; third, it keeps the form of tooth and the pitch after repeated sharpening; fourth, it is free from errors of indexing.

* * *

Steel plate of large size has been cut by the oxy-acetylene process at Sandy Hook by the Oxweld Acetylene Co. under a government contract for cutting 4000 tons of armor plate into sections of suitable size for furnace charging. In carrying out this work, plates 9 feet by 13 feet by 3 inches thick, weighing between 7 and 8 tons each, were readily cut into sections 13 inches by 25 inches, weighing about 300 pounds. This is believed to be one of the largest jobs of the kind that has ever been undertaken, and the oxy-acetylene process is undoubtedly the only one by which salvage work of this nature can be satisfactorily handled.

HIGH-SPEED DRILLING

All previous records for drilling in machine steel and cast iron are said to have been broken by the performance of milled high-speed drills, made by the Cleveland Twist Drill Co. and taken from stock, at several demonstrations at the convention of the American Railroad Association at Atlantic City. In these tests, 1- and 1¼-inch drills penetrated through cast iron at the rate of 72 inches per minute, a 1-inch drill cut through machine steel at the rate of 30 inches per minute, and a 1¼-inch drill cut through machine steel at the rate of 20 inches per minute. The data resulting from these tests, which were performed on a Foote-Burt heavy-duty drilling machine, are conveniently arranged for reference in the accompanying table.

While these demonstrations indicate the very great amount of reserve in modern milled high-speed drills, it is not recommended that the high rates of speeds and feeds at which the drills were operated in these tests be used in ordinary shop practice. For instance, it will be observed that when drilling cast iron, the 1-inch drill was run at the rate of 720 revolutions per minute, with a feed of 0.100 inch per revolution. If this drill were operated according to what is considered good practice, the speed would not be greater than 267 revolutions per minute and the feed approximately 0.015 inch per revolution. The same is true concerning the feeds and speeds used in the drilling of machine steel.

DATA OF DRILLING TESTS

Material	Size of Drill, Inches	R.P.M. of Drill	Feed per Revolution, Inch	Peripheral Speed per Min., Feet	Number of Inches Drilled	Penetration per Min., Inches	Amount of Metal Removed, Cubic Inches	Weight of Metal Removed, Pounds
Cast Iron	1	720	0.100	188	9	72	56.55	14.70
Machine Steel	1	600	0.050	157	3	30	23.56	6.64
Cast Iron	1¼	720	0.100	236	15	72	88.36	22.97
Machine Steel	1¼	500	0.040	164	3	20	24.54	6.91

Machinery

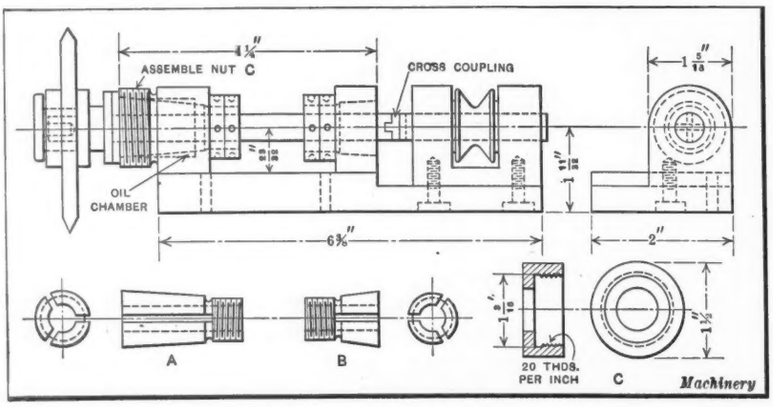
COOPERATIVE COURSE IN ELECTRICAL ENGINEERING

For the past year an interesting experiment in cooperative engineering education has been conducted by the Massachusetts Institute of Technology, Cambridge, Mass., and the General Electric Co., at Lynn, Mass. While the cooperative scheme in itself is not new, several departures from the usual plan were introduced, which are said to have produced highly satisfactory results. The course covers a period of five years, the first two years being identical with the regular course in electrical engineering at the institute, and the last three being divided between instruction in theory at the institute and instruction in practice at the Lynn works. The class was limited to thirty students, who were chosen entirely upon the records which they had made in the first two years' work of the electrical engineering course. Included in this group were graduates from Yale, Harvard, Dartmouth, Princeton, the Naval Academy, besides men who had completed their first and second years solely at the Massachusetts Institute of Technology. The year is divided into four three-month periods, the students spending alternately thirteen weeks at the Lynn works of the General Electric Co., and eleven weeks at the institute followed by a two weeks' vacation. No break is made in the major studies when the students are at Lynn, courses being conducted at the works in principles of electrical engineering and in general studies. The progress of the students through the plant is regulated not by the production needs of the various departments, but by the advantage which the experience in each department is to the student. The result of this year's work has been so gratifying to the originators of the plan that the General Electric Co. has increased the number of men who can be enrolled in this year's class to sixty, and has secured a new club house in order to furnish rooming accommodations for them.

PRECISION THREAD GRINDER

The high degree of accuracy demanded in modern thread gage manufacture has led to the development of various types of thread grinding attachments. By employing grinding as a means of correcting distortion, caused by hardening, a thread can be produced which will be accurate in lead to less than 0.0001 inch. The practice of grinding hardened thread gages represents the highest attainment reached in the manufacture of precision thread gages.

A thread grinding machine of the bench lathe type, has recently been designed by H. Wiederhold, of the Diehold Mfg. Co., Brooklyn, N. Y. This machine is simple in construction, and it is claimed that it will produce an accurate lead to within 0.0001 inch. The machine will handle both external and internal work, and may be set for grinding gages up to and including 6 inches in diameter. A special slide-rest is mounted on the base of the thread grinder to which is fitted an auxiliary slide in which there are three parallel T-slots. These slots are used for locating on this auxiliary slide the grinding wheel and its mounting, as well as the attachment for truing the wheel. The design of the mounting for the wheel-spindle is shown in the accompanying illustration. A cast-iron base is bored out in the pulley-end bearing to fit the diameter of the shaft, and in the other two bearings to fit special bushings *A* and *B*. These bushings are made of high-carbon steel and are tapered and threaded on the outside to receive adjusting nuts. The bushings, as well as the high-carbon steel shaft, are hardened, ground, and lapped to an accurate fit. This construction allows adjustment to compensate for wear, and in addition it permits the end-thrust to be taken in both directions.



Grinding Wheel Housing Design for Thread Grinding Machine, in which Special Provision is made to prevent Vibration of Wheel

The grinding wheel is secured to the shaft as shown, its center bushing accurately fitting the lapped end of the shaft. Between the wheel end of the shaft and the pulley end provision is made to overcome vibration caused by the belt hook by constructing the shaft in two pieces, coupled together by means of a "cross." This coupling resembles an Oldham design, but its purpose is not so much to enable correction for misalignment, as to provide a means whereby the motion produced by the lateral thrust will be lost. There is a slight lateral movement permissible between the two connected shafts and the lugs of the cross to which they fit, which absorbs the vibration that otherwise would be transmitted to the wheel. With this arrangement, however, and proper adjustment by the means provided, the wheel will operate without the slightest amount of lateral play. Between the phosphor-bronze thrust bearing nut *C* and the adjacent bearing, a phosphor-bronze check-nut is employed.

This grinding wheel unit is attached to an angle-plate which is located on the auxiliary slide previously mentioned. The spindle is mounted at the correct helix angle of the screw thread on the vertical side of the angle-plate, and a tongue is provided on the seat of the plate to fit into one of the T-slots in the auxiliary slide. The button method or the use of a sine bar will enable this location to be accurately determined. The spindle bearing casting is drilled to receive a bolt, and a radial slot is provided in the angle-plate so that the desired location can be readily secured. Having established the correct angle for the wheel location, the depth of cut and the relation of the wheel to the flanks of the thread may be easily obtained by means of the graduated operating screws in the slide-rest.

The gage to be ground is mounted on a suitable spindle, which is in reality a combination spindle and master lead-screw. This tool-steel member is mounted in two bearings in the headstock, the front one of which is a split bronze bearing in which the spindle end fits. The lead-screw end of the spindle is carried in a babbitted bearing at the rear end of the headstock. The front bearing is provided with a cap which enables the spindle to be removed when it is desired to install a spindle having a lead-screw of different pitch. It is, of course, necessary to repour the babbitted bearing when changing the master lead-screw.

The end of the lead-screw is ground down to receive the driving pulley which is mounted on it and belted to suitable pulleys carried on an auxiliary shaft, located at the front of the machine. There are three pulleys carried on this auxiliary shaft, two fixed ones belted open and crossed, and one idler. By this means, the gage may be traversed back and forth over the grinding wheel until the desired limits have been attained. Ordinarily from 0.0010 to 0.0012 inch is left for grinding so that several traverses over the wheel are required.

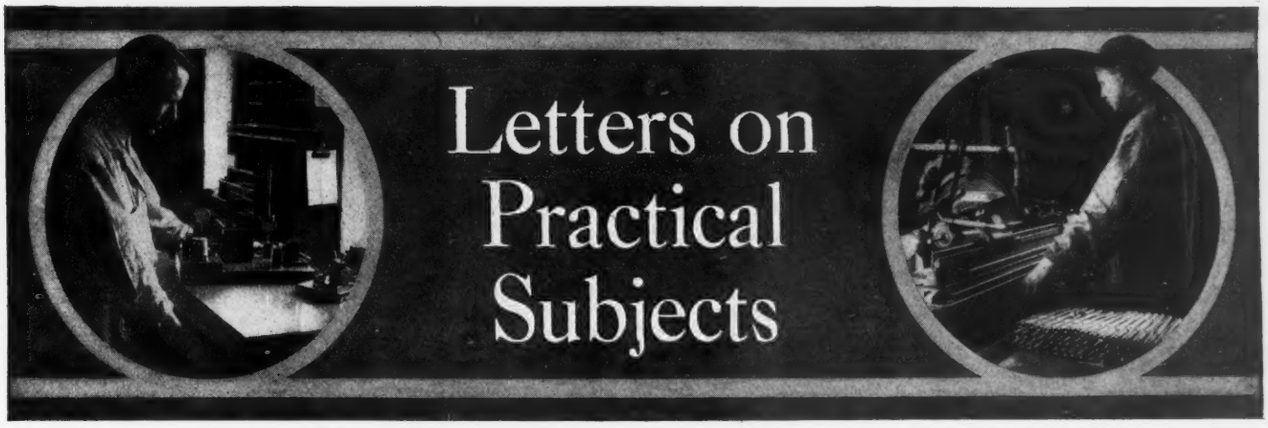
The grinding wheel may be driven by a suitable motor mounted above the machine, which is belted to transmit to the wheel a speed of from 7000 to 10,000 revolutions per minute. A felt washer is employed between the gage on the spindle and the front bearing so as to exclude all grit and foreign substances; the bronze bearing nut *C* serves the same purpose for the wheel-spindle. The provision of parallel T-slots on the auxiliary slide previously referred to enables a diamond truing attachment to be mounted on it for the purpose of maintaining the correct thread angle when dressing the wheel. This attachment is mounted in relation to the grinding surfaces of the wheel either by means of buttons or by employing a sine bar, as in the case of mounting the wheel at the correct helix angle. When the work is to be held between centers, a special tailstock is provided.

* * *

COUNCIL OF A. S. M. E. ADOPTS RESOLUTION REGARDING METRIC SYSTEM

Recently a number of articles have appeared in various publications stating in effect that the American Society of Mechanical Engineers had placed itself on record as being opposed to the metric system. This matter was presented to the council of the society and the following resolution was adopted: Resolved, that this society, as a society, does not and has not taken any stand in favor of or against the metric system, that notice to this effect be published in the journal of the society, *Mechanical Engineering*, and that this fact be given such further publicity as may be approved by the president.

It was the unanimous opinion of the members of the council, both at the meeting in Baltimore on February 27 and at the March 19 meeting, that while members of the society and of the council might properly and would naturally hold various opinions regarding the metric system and its introduction here, it was not advisable nor desirable that the society place itself on record either for or against the system or its introduction.



AIR CHUCK ATTACHMENT FOR THREADING STUDS

The set-up shown in the accompanying illustration was used on a Garvin screw machine for the purpose of rapidly threading one end of plain studs, which had previously been threaded on the opposite end and cut off to length. This attachment is not only quick-acting, but it has also been found to give the highest degree of satisfaction on this and similar kinds of work.

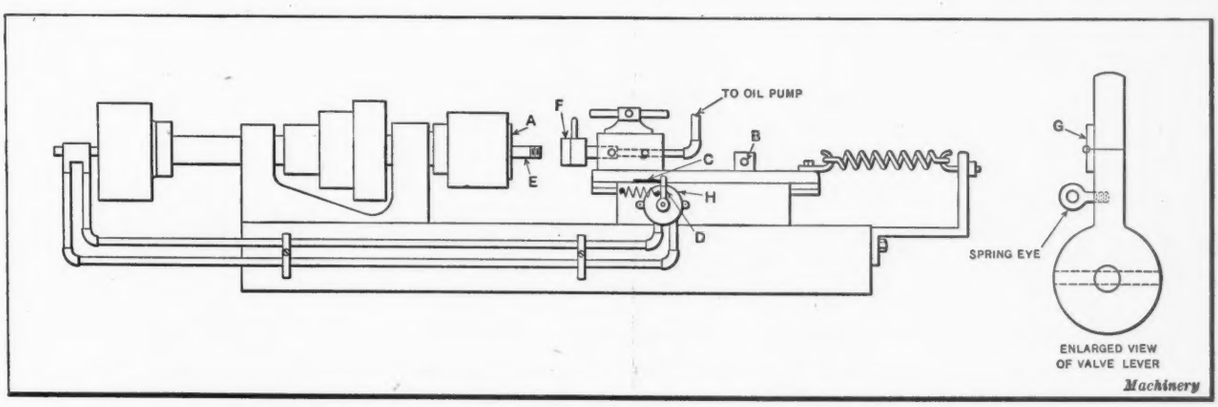
The chuck employed for the job is of the common air-operated type, equipped with threaded pads to suit the thread of the stud, by means of which the stud is held. These pads are made from tool steel, and are nicely fitted in the chuck and matched so that their sides close tightly together. The pads are then drilled out and tapped, a recess at the bottom of the hole being made so that the studs may be screwed in and bottomed in the hole. The pads should be hardened and tempered, and numbered to correspond with the numbers of the chuck jaws, so as to facilitate the work of putting the pads back into their respective positions, should the occasion require. A bracket made from cold-drawn steel is attached to the end of the machine and carries a hook to which a coil spring is attached. The purpose of this spring is to draw the carriage of the machine back as soon as the operating lever *B* is released. After the operating lever has been manipulated and the carriage traversed away from the chuck, a suitable dog or cam *C* attached to the carriage will contact with the valve lever *D*, pushing it back and thereby operating the air-valve *H*. This valve is constructed so as to allow the air to pass into the air cylinder and thence to the chuck jaws. As soon as the chuck has been opened and the stud *E* permitted to drop out, the cam *C* will have passed over the air-valve lever *D*, which will then be pulled back into its original position by means of a light coil spring. This automatically closes the air chuck, enabling the operator to insert another stud in the chuck with the machine still in motion, draw up the carriage by operating lever *B*, and by means of the self-opening die-head *F*, cut the thread to the desired length.

The construction of the valve lever *D* is shown enlarged at the right-hand side of the illustration, from which it will be seen that the lever consists of two parts, fastened together by means of the spring hinge *G*, the purpose of which is to enable the end of the lever to snap back as soon as the cam *C* on the carriage has passed over it on the forward movement, thus instantly closing the chuck jaws preparatory to threading another stud. It will be seen that the cutting oil is delivered to the work by means of a small iron pipe passing through the turret of the machine and into the shank of the die-head. A suitable valve is used to regulate the flow of the oil. This system of oiling not only delivers the cutting oil directly to the work, but also washes away the chips from the die-head. On a machine equipped with the arrangement illustrated, an average hourly output of 900 studs, ¼-20 by 1 inch, was obtained.

Cicero, Ill. JOHN J. BORKENHAGEN

DIES FOR DRAWING A DIFFERENTIAL GEAR CASE

The first operation performed in drawing the differential gear case illustrated consists of cutting out the blank from stock 5/32 inch thick. The diameter of this blank is 9 inches, and for the performance of the second operation, the blank is placed between the two steel rings *H* and *C*, Fig. 1, for the purpose of forming it to the shape shown at *A*, Fig. 2. These rings are fastened to the blank-holder casting *L* and to the die-block *B* to which they are fitted by means of annular tongues and grooves, and secured by means of machine screws. The locating ring *R* on the outside of the die ring *C* locates the blank concentrically with the die. In the operation of this die which is of the double-action type, the blank-holder *L* descends before the punch *F*, and holds the blank on the surface of the die ring while the punch descends and performs the drawing operation. At the end of the stroke of the press, the punch ascends in advance of the blank-holder so that, if the shell should stick on the punch, the blank-holder ring would strip it from the punch as the latter



Set-up of Garvin Screw Machine for threading Plain Studs. A suitably Regulated Air Chuck is employed to hold the Work

travels upward through it. The third operation reduces the shell to the final body diameter as indicated at *B*, Fig. 2. The knock-out *K*, Fig. 1, employed in the punch is set in as shown, thus permitting a larger bearing surface on the bottom of the shell for ejecting it from the punch. For producing heavy shells of large diameter, such as the one shown, this construction is advisable. The die ring *C* is inserted in the die-holder *B* and is held in place by ring *A*, which acts as a gage ring for locating the shell.

The die used in performing the fourth operation (see Fig. 1), is provided with two knock-outs *E* and *K*, located as shown in the punch and die, respectively. It will be noted that the punch does not entirely fill the shell, it being necessary for it to enter only the small diameter, as the operation is confined to this end of the shell. The three succeeding operations are not illustrated, for the reason that they consist merely of changing the shape, step by step, and reducing the small end preparatory to performing the final operation. The shape of the shell after the final, or eighth, operation has been completed, is shown at *D*, Fig. 2, and the dies employed are shown in the lower right-hand corner of Fig. 1. The operation consists of flattening the flange and of finishing both the large and small diameters. In this operation, the small end of the shell is reduced 1/32 inch while it is being sized. The die consists of two steel rings *C*, the smaller of which reduces the small diameter and is located within the larger ring which is employed in the flattening of the flange. This ring is held down by the gage ring *A*. Attention is directed to the fact that the punch-holder is employed to shape the flange against the larger die ring as the press ram completes its downward stroke. The entire arrangement and construction of the dies provides adequate rigidity. Like all other dies of this kind in which heavy work is performed, the holders should be built up strongly, so as to withstand the strain exerted upon them during the drawing operation.

The dies used on this job are all hardened and ground to a taper of 1½ degrees and are carefully fitted in the die-blocks. The methods employed in drawing this shell demonstrate the fact that, in drawing flanged shells, the flanges should not be formed first, unless it is absolutely necessary; it is a comparatively easy matter to form the flange after the rest of the shell has been drawn. In some cases, however, it may be necessary to form the flange first and make all the reductions and drawing operations afterward.

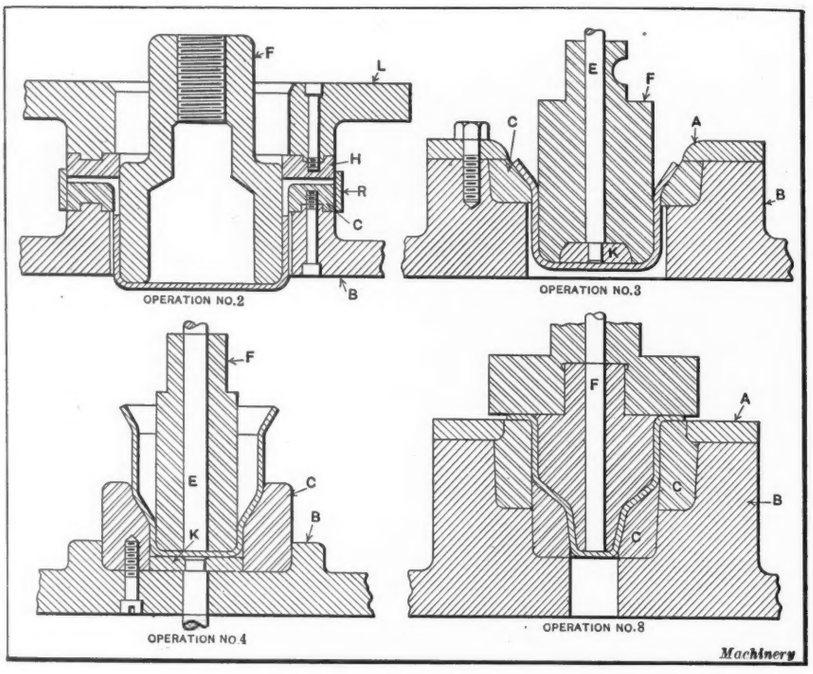


Fig. 1. Principal Dies employed in drawing a Differential Gear Case

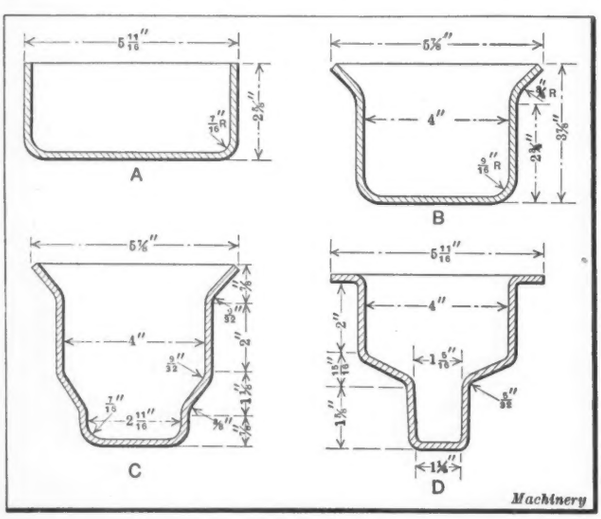


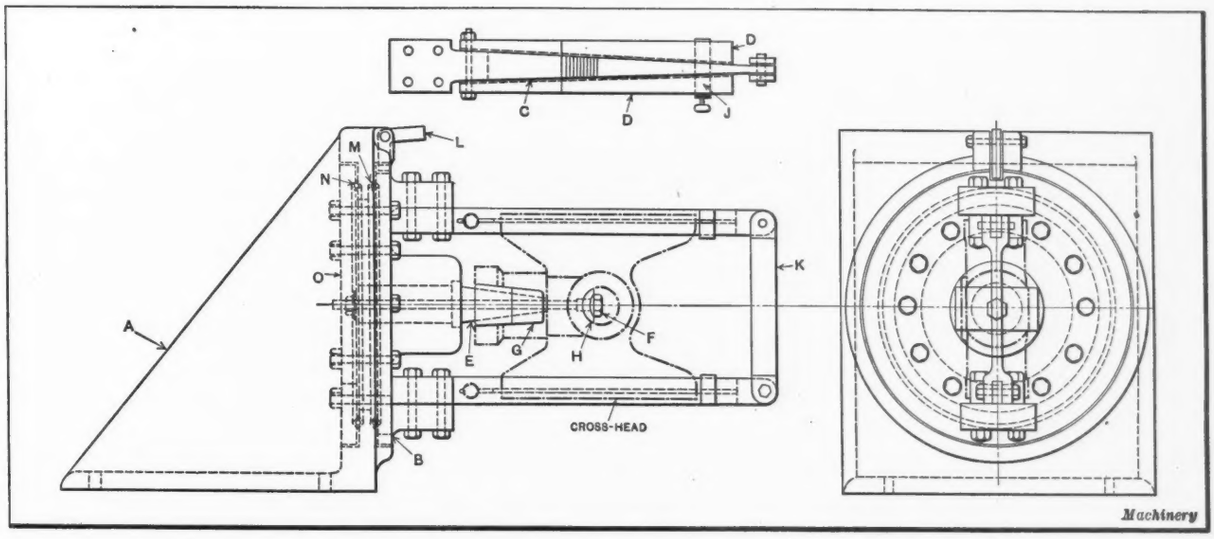
Fig. 2. Appearance of the Case after the Second, Third, Fourth and Eighth Operations

Toledo, Ohio J. BINGHAM

INDEXING JIG FOR BABBITTING LOCOMOTIVE CROSS-HEADS

An indexing jig that was designed to facilitate the babbitting of the surfaces of locomotive cross-heads that bear against the cross-head guides, is shown in the accompanying illustration. By its use it is unnecessary to machine these bearing surfaces after they have been babbitted. This feature makes the babbitting of cross-heads by the use of this jig an economical method, because it considerably reduces the time and labor required in the operation. It will be noted that the principal parts of the jig are the base *A*, the indexing head *B*, the fixed guide bars *C*, and the adjustable guide bars *D*. The indexing head is provided at the center with a boss which is bored to receive a steel mandrel *E*. This mandrel has a 1¼-inch hole running its entire length to receive bolt *F*, and its projecting end is machined to suit the tapered hole in the expanding bushing *G*. The three sections of this bushing are held together by a spring band.

When placing a cross-head on the jig, the expanding bushing is inserted in the hole provided in the cross-head for the end of the piston-rod. The rounded plate *H*, which has a square hole in it to suit bolt *F*, is then placed through the wrist-pin holes, after which bolt *F* is inserted in the holes in plate *H* and mandrel *E*. The nut on bolt *F* at the opposite end of the mandrel is then tightened, thus drawing the cross-head and expanding bushing up on the tapered surface of mandrel *E* and causing the bushing to expand. This action secures the cross-head so well in place that it is prevented from turning about the bushing. Bars *C* and *D* are made to occupy the same amount of space on the upper and lower sides of the cross-head, as is taken up by the guides on the locomotive. After bars *D* have been adjusted until the width across the two bars is the same as the width of the guide on the particular cross-head being babbitted, they are clamped in this position. The babbitting metal is then poured between these bars and the cross-head casting, the babbitt filling all the space between them, so that the cross-head may be mounted on the locomotive without requiring the babbitted surfaces to be machined. The adjustment of bars *D* is such that a sufficient amount of play between the cross-head and the guides is allowed.



Jig of the Indexing Type used when babbitting the Surfaces of Cross-heads which bear against the Cross-head Guides

It will be seen that the fixed bars *C* are bolted to lugs on the indexing head. The adjustable bars *D* are provided with grooves that fit corresponding tongues on bars *C*. Graduation lines are scribed on the fixed bars and an index line is scribed on each adjustable bar to facilitate setting to the proper width. After the adjustment has been made, the nuts on the bolts at the left-hand end of the adjustable bars are tightened, while the opposite ends of the bars are held together by means of the clamps *J*. The ends of bars *C* farthest from the indexing head are tied together by means of link *K* after the cross-head has been placed on the jig. The indexing head may be revolved through a complete circle, there being two slots cut 180 degrees apart on the periphery of the flange for the purpose of locating the head for babbitting either the upper or the lower bearing surface of the cross-head. One end of the locking lever *L* is placed in either of these slots in order to hold the indexing head in the desired position.

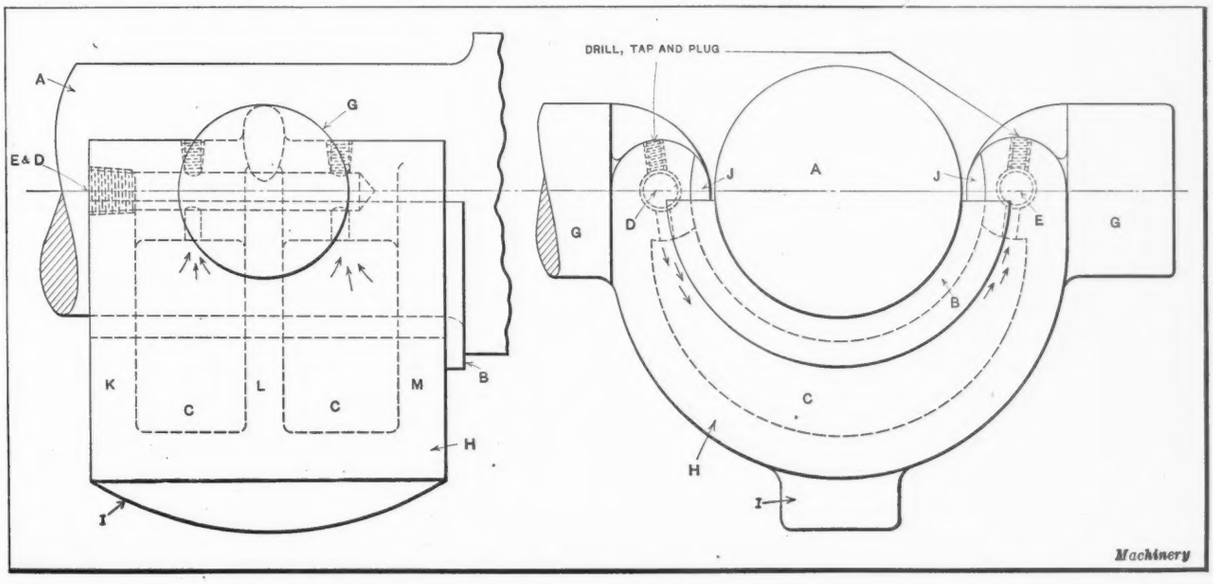
A ball bearing race *M* having 123 balls, ¾ inch in diameter, is provided between the indexing head and base *A* while a similar race *N* is situated between the base and the retaining plate *O*. These ball races make the rotating of the indexing head a comparatively easy matter. Expansion bushings of five different diameters are provided to suit the piston-rod hole in the five various sizes of cross-heads that can be accommodated in this jig. The base *A* should be bolted to a firm concrete foundation near the furnace used for melting the babbitt, and should be placed at such a height above the floor level that the workman need not stoop when pouring the metal.

NORMAN MCCLEOD

IMPROVED DESIGN FOR WATER-COOLED JOURNAL BOXES

A common design for water-cooled journal boxes employs a cored water pocket. There are some objections to this design particularly in regard to the molding proposition, because no matter how carefully the cores are made and set in the mold a certain amount of uncertainty exists in regard to the condition of the cored pocket. This may be readily understood when it is stated that there are two or three stud cores employed in the drag to support and secure a somewhat heavy and overbalanced core in the mold, as well as a like number of stud cores in the cope for centering and setting the core. There is no way of examining the casting to ascertain the condition of the pocket, and even though water may run freely through it, this does not indicate that the water passages and pockets are free from all obstruction. This design also makes it inconvenient to remove the core and core-rods from the castings when cleaning them.

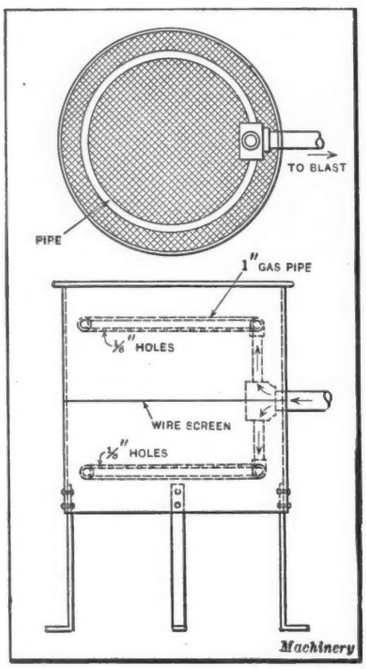
As an illustration of the difficulties encountered in this design, an instance is cited in which considerable trouble was experienced by the journal heating. A careful examina-



Water-cooled Journal Boxes designed to avoid Difficulties in Molding

tion did not disclose anything wrong in the water passages or pockets of the journal bearing. The suspicion that the bearing casting was responsible arose from the fact that the core-rods could not be removed in cleaning the casting. Later when the casting was broken it was found that the metal had run into the joint in the core and had thus formed a wall across the water passage with an opening around the core-rods merely large enough to allow the water to leak through.

Knowing faults of this nature to exist and the reason for them, the writer designed a water-cooled box which is radically different from the usual design. It will be seen from the illustration that the box is of the rocking type, that is, it is provided with trunnions *G* by means of which it is mounted in the copper rolling machine for which it was designed. It is evident that the shaft *A* bears in the brass liner *B*, which is a press fit in the casting, being supported by the three ribs *K*, *L*, and *M* and locked in place by means of four lips located between these ribs and projecting out over the brass liner as shown at *J*. The liner may be made in the form of a ring and then split, since the lips *J* extend below the center line ⅛ inch, or enough to allow for the width of the saw.



Air Box with Coils of Pipe having Hole through which Air is blown

It will thus be seen that for molding purposes the water chambers *C* are open and exposed to view, so that no doubt exists as to their condition. The lips for locking the press liner in place form part of the body *H* of the casting, but do not interfere in any way with finishing the seats for the brass liner which, of course, must be done in order to make the pockets water-tight. The casting is drilled and tapped for water pipe connections at *D* and *E*, and these two holes are connected by two other holes with the water chambers. Holes *D* and *E* are tapped and plugged at the top, as shown in the illustration. The drilling of the holes in the casting does not weaken it to any noticeable degree. The water enters at *D* and from this inlet passes through the chamber and then through the outlet at *E*. By this means the water has a more direct effect as a coolant than would be possible in the more common type of bearing. The bottom of the casting is designed with a seat *I*, as shown.

Kenosha, Wis. M. E. Duggan

AIR-COOLER FOR HARDENING HIGH-SPEED STEEL

Considerable difficulty is often experienced when hardening air-cooled steel, owing to the arrangement of the air blasts for uniformly cooling the work. Many contrivances have been devised to overcome this difficulty. The arrangement shown in the accompanying illustration has been used by one of the leading small tool manufacturers with satisfactory results. This arrangement allows the air to come in contact with the work at every side so that all sections may be hardened at the same time.

The device consists of a cylindrical sheet-iron hood riveted to four strap-iron legs, within which coils of 1-inch gas pipe are arranged as shown with suitable connections to the blast. These coils of pipe are perforated with ⅛-inch holes, spaced 1 inch apart, and so located on the pipe that the blast of air will be directed at an angle toward the center of the box. Between these two coils a ½-inch mesh wire screen is provided on which the work is supported. By this simple arrangement the desired results are attained. The air may be furnished from a blast pipe, or the coils may be connected to a compressed air pipe, according to which one may be handier. The air blast, however, is the better one to use, as the air is drier and therefore is not so liable to cause checks in the surface of the steel. R. F. M.

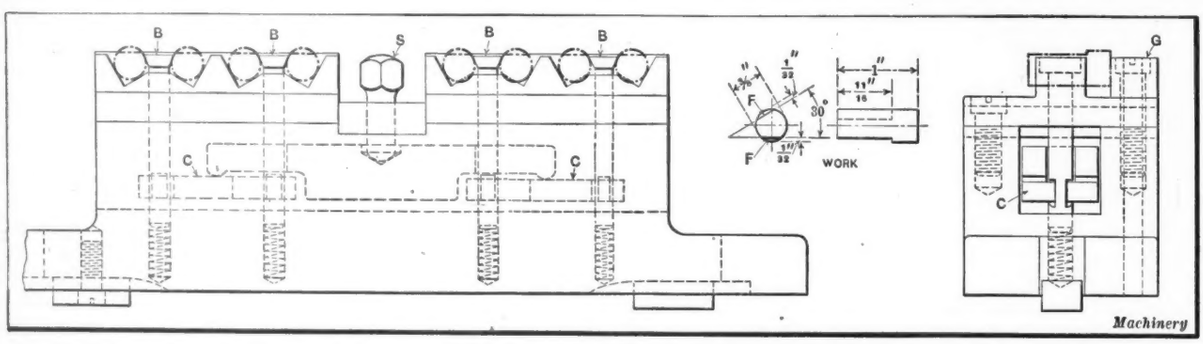
MAKING TABLES ON TRACINGS

When titles and tabular matter have to be changed, as is often the case in drawing-room work, the lines of the table usually become erased, as well as the data. The extra amount of work involved is needless and can be avoided by following the method here recommended. If the lines forming the table in which the data are entered are placed on the back of the tracing, erasures may be made without danger of impairing the appearance of the table on the blueprint. Obviously much time will be saved by following this simple idea. The appearance of the drawing will also be preserved, for the patching up of partly erased lines usually spoils their appearance. The writer has found this practice of value and thinks that it will doubtless be useful to other draftsmen who have not previously been familiar with it.

Philadelphia, Pa. John Kloster

MILLING FIXTURE

The milling fixture here described and illustrated was used for holding the work shown in the illustration while milling the two flats *F* at a 30-degree included angle. Each block on which the work is held has double vees machined in it, between each pair of which there is a bolt with a wedge-shaped head that clamps the work. These bolts are spring-actuated, and linked together so as to be operated by one screw *S*. Links *C* are slotted at each end, and in these slots



Special Milling Fixture and Type of Work for which it is used

the slabbed portion of each bolt fits. This arrangement is more clearly shown in the end view. The left-hand side of the fixture carries four pieces of work during the first milling operation, while at the right-hand side the remaining flats are milled, the work being located from the previously milled surfaces. In machining the vees in the right-hand side of the fixture to bring all cuts in line, the surfaces against which the flats bear had to be made a little higher than the surfaces of the vees contained in the left-hand side of the fixture. The work abuts against strip *G*, which serves not only as a stop for the work but also as a gage for the depth of cut.

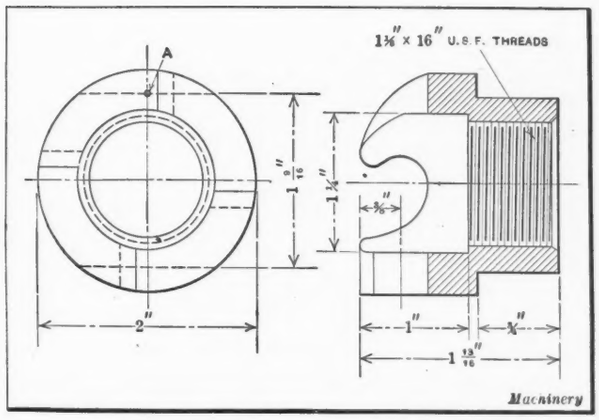


Fig. 1. Crankshaft Gear Nut in which Four Notches are milled

Richmond Hill, N. Y. J. PLASTARAS

MILLING CLAW NOTCHES

For the purpose of milling four claw notches in the crankshaft gear nut shown in Fig. 1, a special milling fixture was designed. This fixture is illustrated in Fig. 2, which also shows the work in place and its relation to the cutter when performing the operation. The nuts are made of cold-rolled steel, cyanide hardened. The preliminary operations consist of drilling, reaming, counterboring, and tapping. Two flats are then milled on opposite sides, after which the piece is ready to be machined in the special milling fixture. The base of the fixture contains a slot 1¼ inches wide by means of which it is located on the milling machine table at an angle of 45 degrees. The fixture is secured to the table by means of bolts engaging the T-slots. The cutter shank *B* is driven into the machine spindle, and the form cutter *A* screwed on, both members being held in the spindle by means of a ¾-inch draw-bolt. The crankshaft gear nut is screwed on the threaded end *C* of the fixture spindle, the wrench being applied to the flats previously milled in the sides of the work. After the work has been thus firmly screwed in place, a lever *D* is inserted in the end of the work-spindle for the purpose of rotating the work through an arc of 90 degrees. As the rotation occurs, cam *E* advances the work against the force of coil spring *G* so that it is brought into contact with the revolving cutter.

This operation is done manually, and at the termination of the travel the claw is milled to the correct shape. After each groove has been milled the index-pin *F* is removed and the spindle indexed 90 degrees before taking the next cut. It is obvious that the action of spring *G* will force the spindle back from the cutter immediately after the operator releases the lever *D*. Care must be exercised when setting the fixture on the machine so that the correct distance from the spindle will be obtained, and the center line of the machine spindle should lie in the same plane as the center line of the work-spindle and be set so that the cutter will be brought into contact with the work at point *A*, Fig. 1. It is necessary that this relation between the work and the cutter be obtained, as otherwise the cutter may cut into the lower side of the work.

This fixture was originally used on a small horizontal milling machine, the production rate being five minutes per piece from floor to floor. Although the fixture is hand-operated, it has been used for machining various sizes of these nuts and has given entire satisfaction. The degree of accuracy that is obtainable by the use of this fixture depends principally upon the accuracy of the cam slot. Obviously a new cam slot must be designed for each new nut in order to take care of the clearances between the cutter and the work, which are very small.

Pittsburg, Pa. W. OWEN

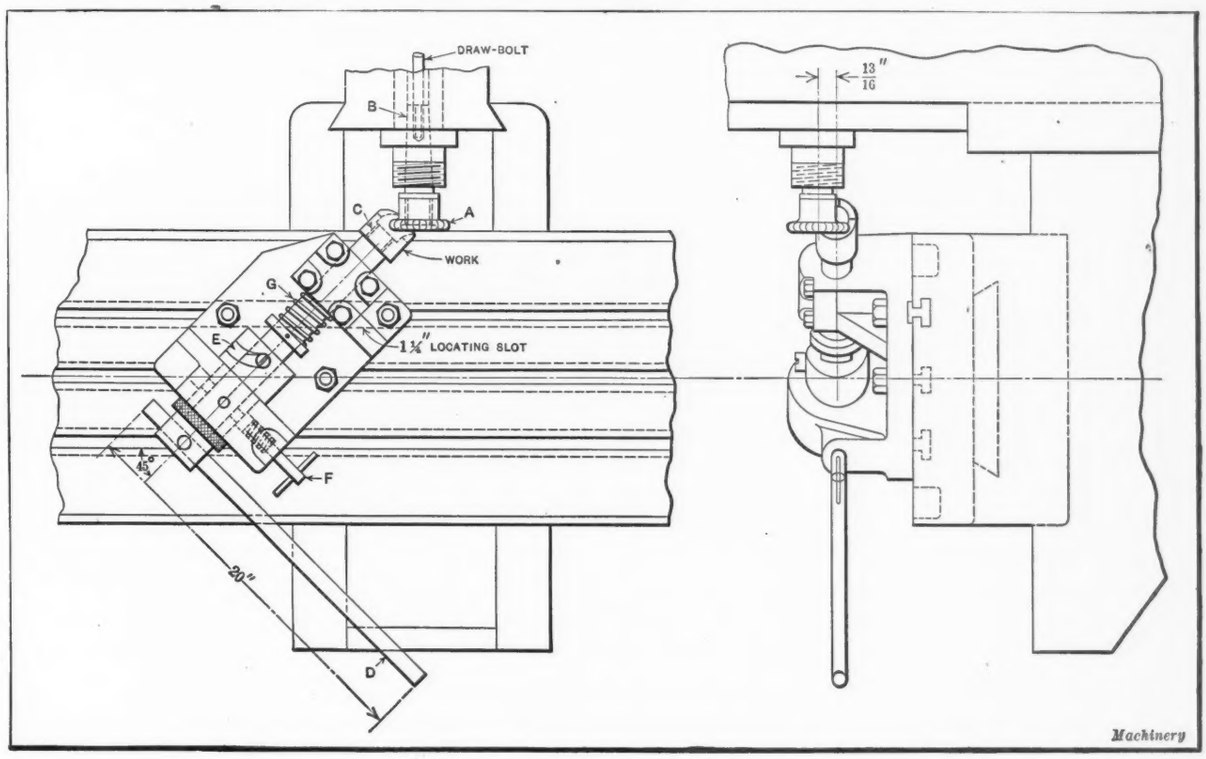


Fig. 2. Special Milling Fixture used in machining Claw Notches in a Crankshaft Gear Nut

FINDING THE RADIUS OF A SMALL DISK

The accompanying diagram illustrates a method for determining the radius r of a disk or cylinder by means of a depth micrometer used in connection with a V-block and a ground disk of known diameter. Measure the distance H from the top of the standard disk to the top of the piece that is to be tested, using a depth micrometer, and calculate r from the following formula, in which R represents the radius of the standard disk.

$$r = R - H \ (2.41422)$$

The derivation of the formula is as follows: In the triangle CDE,

$$b = 45 \text{ degrees} = \frac{a}{2}; \ CD = R + H; \text{ and } CE + X = R.$$

But

$$CE = (R + H) \cos b$$

and

$$X = r - r \sin b = r \ (1 - \sin b)$$

Therefore, substituting for CE and X,

$$(R + H) \cos b + r \ (1 - \sin b) = R$$

$$r \ (1 - \sin b) = R - (R + H) \cos b$$

$$= R \ (1 - \cos b) - H \cos b$$

$$r = \frac{R \ (1 - \cos b) - H \cos b}{1 - \sin b}$$

$$r = R \frac{1 - \cos b}{1 - \sin b} - H \frac{\cos b}{1 - \sin b}$$

But

$$\frac{\cos b}{1 - \sin b} = \frac{\cos b}{\text{vers cos } b} = \sec b + \tan b$$

Therefore

$$r = R \frac{1 - \cos b}{1 - \sin b} - H \ (\sec b + \tan b)$$

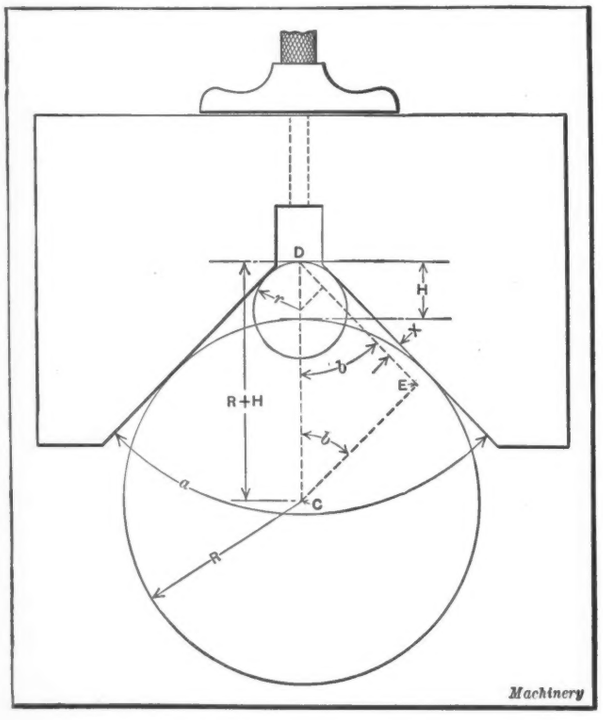


Diagram illustrating Method of determining Radius of a Ground Disk or Cylindrical Part

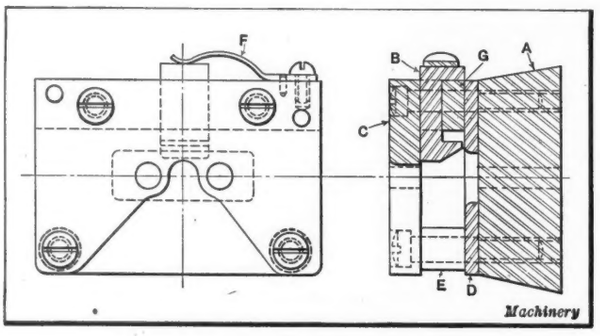
Now since angle b equals 45 degrees, $\frac{1 - \cos 45 \text{ degrees}}{1 - \sin 45 \text{ degrees}} =$ 1; and sec 45 degrees + tan 45 degrees = 2.41422

$$r = R - H \ (2.41422)$$

Richmond College, Va. V. E. AYRE

AUTOMATIC EJECTOR FOR PIERCING DIES

The device here described may be applied to almost any piercing die and will save a great deal of time by ejecting the work after it has been stripped from the punch without the necessity of removing it from the nest by hand. This ejector is positive in action and can be readily applied for ejecting almost any type of small work. After the work has been pierced and while it still sticks to the punch, it travels up with the punch and bears against the inclined face of the ejector B, forcing this member back against the tension of the leaf spring F. As soon as the work has been stripped,



Device for ejecting Work from Punch Press

the spring immediately snaps the ejector forward and knocks the work clear of the die, so that if a deflector plate or other suitable arrangement is employed, the part can be deposited by means of a chute into a suitable receptacle. When applying this ejector, the riser or separator strip G must be made slightly higher than in the conventional construction, so as to allow it to be slotted for the reception of the ejector B. The stripper is supported at the front of the machine by means of bushings E. It is well, if practicable, to cut away the stripper in front, as shown in the illustration, to facilitate loading. If the production is large enough to warrant it, a magazine and automatic feed may be advantageously used, and for such a combination this ejector adapts itself admirably. If so desired, the attachment may be applied on either side of the die instead of at the back as shown.

Montclair, N. J. ROY V. TERRY

* * *

MOTOR MANUFACTURERS ADOPT RESOLUTION AGAINST METRIC SYSTEM

The Motor and Accessories Manufacturers' Association, at its spring meeting in Atlantic City, adopted a resolution to the effect that the members of the association had formally registered their opposition to the adoption of the metric system on the grounds that it is uneconomic, and that the disadvantages of the metric system are not offset by the advantages. The association expressed its belief that the benefits of the metric system do not justify the enormous expense which would be entailed through the necessary changes in sizes of product and equipment, and through the education of employes and customers. The association went on record as being in opposition to any legislative action which would make the metric system of weights and measures obligatory, and commended to the members of the association the work of the American Institute of Weights and Measures in opposing the compulsory adoption of the metric system.

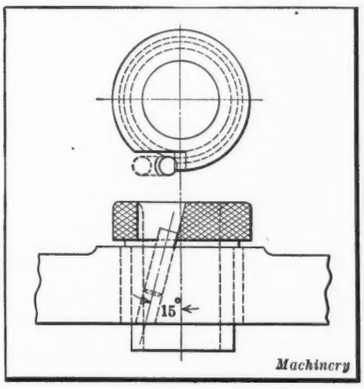
* * *

It has been estimated that the total available water power in the British Isles is about 1,500,000 horsepower, and that the United Kingdom possesses only 1 per cent of the water power and 2½ per cent of the total coal resources of the world. On the other hand, the blast furnaces of Great Britain are said to waste annually 1,000,000 horsepower through not making full use of the waste blast furnace gases.

SHOP AND DRAFTING-ROOM KINKS

SLIP BUSHING FOR DRILL JIG

The slip bushing shown in the accompanying illustration will be seen to be of very simple design. It has a portion milled out at an angle of 15 degrees from the vertical in its outside circumference. In the body of the jig a small dowel-pin hole is drilled at the same angle, so that when the dowel-pin is driven in, it will align with the milled portion of the bushing and prevent it from turning. On account of its angular position the pin also keeps the bushing from working out of the jig when the drill is at work and when the tendency of the accumulated chips is to force the bushing from the jig. In other respects, the bushing is of the standard type with the usual knurled head. B. S.

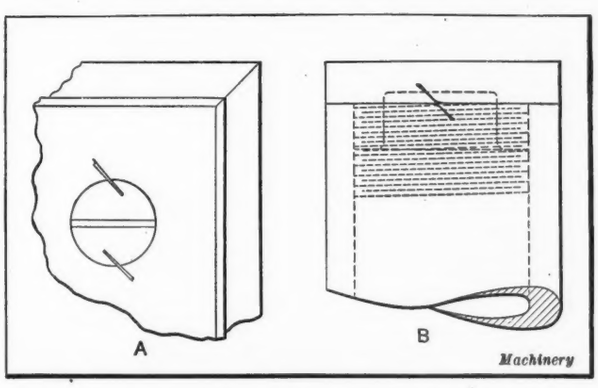


Drill Bushing with Dowel-pin for preventing it from revolving

PREVENTING THE LOOSENING OF THREADED FITS

In assembling, it is frequently necessary to guard against excessive vibration when the parts are fastened by means of screws or when they are screwed together. The peening action produced by vibration is liable to develop looseness. The simple means described here has been used extensively on this kind of work and although simple chisel cuts are used to lock the parts together, these cuts will not mar the appearance of the work if they are neatly and symmetrically placed. A sharp pointed chisel should be employed and the chisel marks should be located as shown at *A* if a round-head screw is employed to hold the parts together. These cuts raise burrs which by their interlocking and overlapping position, will prevent to a considerable degree the loosening of the parts by vibration. The chisel should be held at the proper angle and the cut should be made in the direction indicated; otherwise a cut will be produced which will not give the desired results. The view at *B* shows a cap screwed on a sleeve, the two parts being held together by the same method. In this case the chisel cut is placed diagonally across the joint.

Allentown, Pa. JOE V. ROMIG

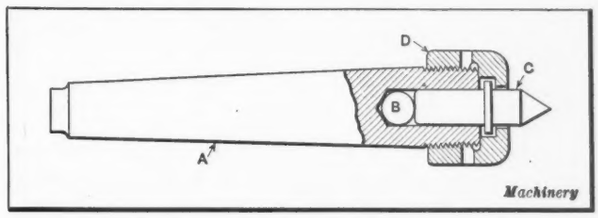


Chisel Cuts, if made with care, may be employed to prevent Parts assembled by Screws from coming loose

REVOLVING LATHE CENTER

The accompanying illustration shows a revolving lathe center designed by the writer, which has proved very satisfactory in supporting both light and heavy work. The center consists of a machine-steel shank *A*, a tool-steel ball *B*, a tool-steel center *C*, and a machine-steel cap *D*. Ball *B* and the shank of center *C*, which is ground to size, are inserted into the drilled and reamed hole in the end of shank *A*, after which cap *D* is screwed on the shank by means of a spanner wrench. Center *C* revolves freely when the work in the lathe is rotated, ball *B* taking up the thrust produced on the center. Some means should be provided for occasionally furnishing lubricant to the ball. When center *C* becomes so worn that it can no longer be reground to the proper shape, it is easy to make a new one.

Bridgeport, Conn. GUSTAVE F. BAHR

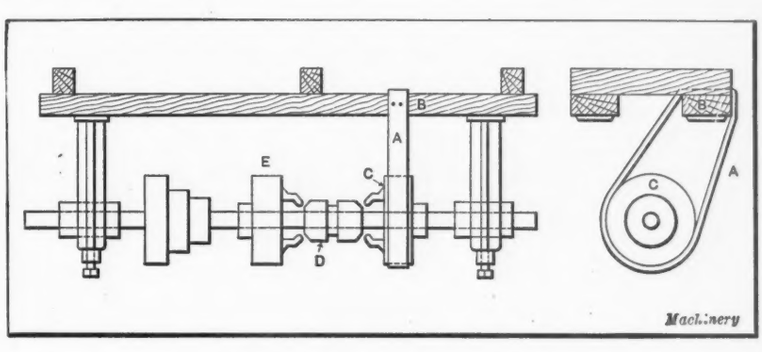


Design of Lathe Center in which the Center rotates freely with the Work

BELT BRAKE FOR COUNTERSHAFT

In many shops, belts will be found so placed over the cone pulleys of lathe heads that they can be used as hand-brakes, thus enabling the operator to stop the rotation of the lathe spindle quickly. While this arrangement is effective, it is not as good as one the writer noticed recently. A leather brake-band *A* was fitted over pulley *C* on the countershaft and fastened to the hanger boards *B* with lag screws and washers. By throwing the shifter lever over so as to disengage the cone *D* from the open belt pulley *E* and engage it directly with the clutch of the reverse pulley *C*, the machine can be brought to a dead stop instantly, thus allowing the operator to remove and replace the finished work in the chuck without loss of time.

Cicero, Ill. J. J. BORKENHAGEN



Countershaft equipped with Brake-band

Slippage Factor in Belt Design

THE great variety of belt applications makes the problem of determining the transmitting power of belting difficult without reference to the many variables that enter into the consideration of any drive. In machine shops, for instance, some of the belts operating near the ceilings are apt to be dry, while others are saturated with oil. On woodworking and textile machinery, belts are often run at very high speeds and over small pulleys, and are constantly surrounded by a fine dust which greatly affects their adhesion to the pulleys. The desirability of being able to determine the proper size of belt for a given transmission becomes more and more important as the cost of belting increases, and although this subject has received much consideration, there is still a great deal to be known before it can be considered as adequately understood. In an article recently published in the *Sibley Journal of Engineering*, by W. N. Sawdon, a review is made of many experiments on the belting problem in the past and of tests made by the writer himself in endeavoring to determine the effect of belt speed upon the coefficient of friction and slip.

Results of Experiments Made by Wilfred Lewis

The first experiments made under conditions corresponding to practical operating conditions were made by Wilfred Lewis for William Sellers & Co., and reported in 1886. The machine designed for the purpose was provided with a dynamometer; a tension weighing mechanism by which the tension in the belt could be measured while the machine was operating as well as when at rest; a slip meter by which the sum of the slips on the pulleys could be accurately measured; and a prony brake for absorbing and measuring the power delivered by the driving pulley. The belt could be tightened or loosened by moving the carriage on which the driven pulley was mounted, in the proper direction. Previous to this time it had been universally assumed that the sum of the tensions in the two sides of a belt remain constant for a given initial or standing tension. The experiments made by Mr. Lewis, however, showed that this is not even approximately true, but that this sum may increase indefinitely. He obtained values of the coefficient of friction varying from 0.251 for a dry oak-tanned belt to 1.38 for a rawhide belt.

The results of the experiments were summed up as follows: (1) The coefficient of friction may vary under practical conditions from 25 to 100 per cent. (2) Its value depends upon the nature and condition of the leather, the velocity of sliding, the temperature, and the pressure. (3) A velocity of sliding equal to 1 per cent of the belt speed is not excessive. (4) With horizontal belts, the sum of the tensions in the two sides of the belt may increase indefinitely as far as the breaking strength of the belt. (5) The economy of belt transmission depends principally upon journal friction and slip. (6) Belt speeds should be as high as possible within the limits of 5000 to 6000 feet per minute. Mr. Lewis also found that the slip due to the extension of the belt is from 1½ to 2 per cent, and therefore 2 per cent slip may be considered allowable and proper.

Effect of Pulley Surface on Belt Slip

In 1909, Carl Barth published a mathematical analysis of the experiments of Mr. Lewis, in which he presented an equation for finding the coefficient of friction. From this equation another was derived to represent the horsepower which a belt would be expected to transmit. Charts and tables for conveniently solving belt problems were also constructed by Mr. Barth. This is considered the most authentic work on this subject up to the present time, but the fundamental assumptions are based upon experiments with one kind of pulley surface, and could not be expected to apply to surfaces in general.

The tests made by Mr. Sawdon were performed in 1910 upon the same machine as used by Mr. Lewis. This machine had been rebuilt but, with the exception of the dynamometer, its operation was precisely the same as when used by its designer. The pulleys used were made of cast iron, and in the preliminary tests it was discovered that the carrying capacity was low, and that as soon as the slip exceeded about 2 per cent, it was impossible to keep the belt on the pulleys. Upon inspection it was found that the pulley surfaces still bore tool marks and were slightly rough, so they were dressed down with emery cloth and oil until all traces of the tool marks were removed and the faces had a smooth polished appearance. With the pulleys in this condition it was found that the slip for small loads was materially increased, but that the belt could be kept on the pulleys without difficulty with slips as high as 10 per cent, and the carrying capacity of the pulleys was greatly increased.

Variation of Belt Slip During Experiment

Another difficulty then developed, and this was the inability to get slip observations which would check from day to day when the speed, tension, and power transmitted were the same. This led to taking continuous slip observations for long intervals of time with the tension fixed and the speed and load constant. It was found that, in general, the slip was high when the load was first applied and that it gradually decreased to what appeared a normal condition, at which time the percentage of slip was very low. It usually required from a few minutes to as much as twenty minutes for this condition to be reached. Changes of slip, however, occurred at any time, during which the slip would increase to an amount even greater than the initial slip and then would gradually decrease as before. The tests were made at a belt speed of 2200 feet per minute and with different conditions of tension and load.

Relative Slip on Pulleys Made from Different Materials

A comparison was also made between the action of cast iron, paper, wood, and cast-iron pulleys with cork inserts. The variation in slip was much less marked with the other pulleys than with cast iron. The following results were obtained in comparing the carrying capacities when the tension was approximately 170 pounds per square inch of belt section, the speed 2200 feet per minute, and the slip 1 and 2 per cent, respectively. Taking cast iron as unity, the comparison made with a slip of 1 per cent was as follows: Cast-iron pulleys, 1; wood pulleys, 1.55; cast-iron cork-inserted pulleys, 1.69; and paper pulleys, 2.40. When the slip was 2 per cent, the results were as follows: Cast-iron pulleys, 1; wood pulleys, 1.14; cast-iron cork-inserted pulleys, 1.34; and paper pulleys, 2.53.

Recent experiments tend to show that the creep is very nearly proportional to the load; that it amounts to 1 or 2 per cent, depending upon the kind of pulleys used and the tension; and that if the load is increased beyond the point where true slipping occurs, the slip increases very much more rapidly than the load, and an unstable condition is soon reached. It would then seem that the point at which real slipping commences should be to the belt designer what the elastic limit of steel is to the bridge designer, and that drives should not be designed to operate beyond the limit of creep.

Activities of the American Engineering Standards Committee

THE Swiss Standards Association has addressed a communication to the national engineering standardizing bodies of various countries, proposing the international standardization of the widths across flats of nuts and bolt heads. The proposal covers bolts ranging from ¼ inch to 3 inches (6 to 80 millimeters) in diameter. The numerical values proposed are a compromise between the U. S. standard, the British or Whitworth, and the metric "Systeme Internationale." This communication has been addressed to the standardizing bodies of America, Belgium, England, France, Germany, Holland, and Sweden.

The American Engineering Standards Committee has requested the American Society of Mechanical Engineers and the Society of Automotive Engineers to act as joint sponsors in the matter, leaving to their decision the question as to whether a new sectional committee shall be organized for the project, or whether the work shall be done by a sub-committee of the sectional committee on screw threads, for which the same two societies are acting as joint sponsors.

Standardization of Structural Shapes

On the entrance of the United States into the war there came a demand for an immediate increase in ship construction which, in turn, meant an increased production by the steel mills. To increase production to the maximum and to simplify the practice followed in ordering structural shapes, a conference of steel makers was held in Washington July 2, 1917, at which American standards for structural steel for ships were adpoted.

Later it appeared that the British standard sections of ship channels and shipbuilding bulb angles were better adapted to economical manufacture than the American standard sections, and as the new rolls which had been turned in recent years to produce such sections conformed in general to British standards, it was decided at another conference of steel makers held in Philadelphia on November 19, 1918, that thereafter American standard sections should be discontinued. Rolls not then coinciding with British standards were to be redressed at as early a date as possible to correspond to British standards. It was believed that the adoption of British standard sections would enable American mills to compete on an even basis for ship steel wherever it is utilized in shipyards, either at home or overseas.

It was subsequently discovered that a revision of the British standards by the British Engineering Standards Association had been in process in 1913, and that this had been interrupted by the war activities. This association advised American steel manufacturers of the situation and expressed its desire to have them cooperate in the formulation of common Anglo-American standards for steel shapes. At the instance of the Association of American Steel Manufacturers, a sectional committee on steel shapes was organized under the auspices of the American Engineering Standards Committee for this purpose. This sectional committee gave very careful consideration to the entire routine of structural practice in the United States, not only as it affects the profiles of structural shapes themselves, but also as regards methods of ordering shapes, and the calculation and publication of weights, areas, and properties, etc., with the idea of insuring as far as possible a complete accord between makers and users wherever the sections rolled in English-speaking lands were used. At its meeting held on April 27, 1920, it formulated its recommendations for submission to its sponsor organizations, to the American Engineering Standards Committee and to the British Engineering Standards Association as a basis for common Anglo-American standards, and its conclusions are now to go before these organizations for further discussion and endorsement. The essential features of these recommendations may be obtained by addressing the American Engineering Standards Committee, 29 W. 39th St., New York City.

Standardization of Pipe Flanges and Fittings

The American Society of Mechanical Engineers has been requested by the American Engineering Standards Committee to assume sponsorship for the standardization of pipe flanges and fittings. In 1914, this society issued a report covering a schedule of pipe flanges and fittings from 1 to 100 inches in diameter for 125 pounds pressure; and from 1 to 48 inches in diameter for extra heavy pipe for 250 pounds pressure. In 1918 a supplementary report was published for working pressures of 50, 800, 1200, and 3000 pounds.

Standardization of Shafting

The American Society of Mechanical Engineers has also been invited to act as sponsor for the standardization of shafting. This society has already done a considerable amount of work on a set of standard diameters for transmission and machinery shafting. It is proposed that the work shall be broadened to include the standardization of the method of determining what diameters of transmission shafting should be used for given loads, the dimensions of shafting keys and keyways, and the setting of dimensional tolerances.

Standardization of Plain Limit Gages

A sectional committee of the American Engineering Standards Committee has been organized to undertake the standardization of plain cylindrical gages for general engineering work, also under the sponsorship of the American Society of Mechanical Engineers. The immediate occasion for undertaking this work was a request by the British Engineering Standards Association for cooperation on the subject. It is understood that this committee will recommend that the scope of the work be broadened to cover all plain limit gages for general engineering work.

Standardization of Safety Codes

Definite arrangements have been made by the American Engineering Standards Committee for the formulation of a considerable number of safety codes. The subjects of the codes for which arrangements have been completed, together with the organizations which will act as sponsors, are as follows: Abrasive wheels, the Grinding Wheel Manufacturers of the United States and Canada, and the International Association of Industrial Accident Boards and Commissions; explosives, the Institute of Makers of Explosives; foundries, the American Foundrymen's Association and the National Founders Association; gas, the United States Bureau of Standards and the American Gas Association; head and eye protection, the United States Bureau of Standards; paper and pulp mills, the National Safety Council; power presses, the National Safety Council; pressure vessels, non-fired, the American Society of Mechanical Engineers; refrigeration, mechanical, the American Society of Refrigerating Engineers; and woodworking machinery, the International Association of Industrial Accident Boards and Commissions,

and the National Workmen's Compensation Service Bureau. A large representative advisory committee of specialists organized by the National Safety Council, the National Workmen's Compensation Service Bureau, and the Bureau of Standards is to decide what additional codes are urgently required and what organizations are in the best position to undertake sponsorship for such codes.

Ball Bearing Standards

In order to cooperate with the Swiss Standards Association in standardizing ball bearings, the committee requested the American Society of Mechanical Engineers and the Society of Automotive Engineers to act as joint sponsors for the project. These societies have accepted and are now organizing a committee that will be thoroughly representative of all the interests involved and be responsible for the detailed formulation of the standards.

There are national standardizing bodies in Belgium, England, France, Germany, Holland, Sweden, and Switzerland, while one is in process of organization in Italy. The American Engineering Standards Committee is in active cooperation with some of these international bodies, the most important project at the present time being that of standardizing steel sections.

* * *

CLEVELAND MANUFACTURERS REPORT ON THE METRIC SYSTEM

One of the most complete reports in opposition to the compulsory adoption of the metric system that has so far been published is that of the Committee on Industrial Development of the Cleveland Chamber of Commerce, upon which committee some of the most prominent members in the machine tool and small tool industry in Cleveland served. This report goes into considerable detail in regard to the points of opposition to the metric system, and contains a detailed statement of the estimated cost of installing the metric system in the office, selling, and administrative departments of a large Cleveland manufacturing establishment. According to the report, the total cost for this entire plant would be $473,965. The report is quite concise and clear, and is of especial value because it goes into details rather than dealing with generalities. The strongest claims made are doubtless those that point out that the English system is already overwhelmingly used in the industrial field. It is mentioned, for example, that the United States makes more than one-half of the screw products of the world and that the system already in use is, therefore, the most interchangeable of any systems which are in use at the present time. It is further pointed out that about 50 per cent of all machine tools manufactured in the world are made in the United States and that 82 per cent of the total business in the machine tool field originates in the United States and in Great Britain, both of which use the English system.

In conclusion the report states: "A great majority of manufacturers are on record as opposing the adoption of the metric system under one of the three heads: (1) It offers no advantage over the present system of inch measurements. (2) It is a very expensive procedure to introduce it. (3) It will produce great complications during the period of transition."

The committee, after consideration of its investigation and of the facts that have come to its attention, earnestly urges the Chamber of Commerce to go on record as being absolutely opposed to the compulsory adoption of the metric system of weights and measures in this country, and strongly recommends that the Chamber of Commerce direct communications to the members of the Committee on Coinage, Weights, and Measures of the Congress of the United States, and to all of the representatives of Ohio in the Congress of the United States, opposing a legislation which will, in their opinion, be disastrous to all of us. The report may be obtained upon application to the Cleveland Chamber of Commerce.

AUTOMOTIVE ENGINEERS PASS RESOLUTION AGAINST METRIC SYSTEM

At the meeting of the Society of Automotive Engineers at Ottowa Beach, Mich., June 22, the members present passed a resolution to the effect that the society is opposed to the compulsory adoption of the metric system. It was further decided to send copies of the resolution to the members of the House and Senate Committees on Weights and Measures. At an earlier meeting the Aeronautic Division of the Society of Automotive Engineers recommended that the English system of measurements be used, except in isolated cases. This decision was unanimously adopted, not only by the Division of Standards, but by the society.

In order to ascertain the views of members of the society many of whom did not attend the convention, a questionnaire was sent out by *Automobile Topics*, and the results published in the June 26 number under the heading "Metrics Not in Favor," the results being that out of 967 votes, 250 favored the compulsory adoption of the metric system in this country and 717 were opposed to its adoption. In answer to the question of preference for personal use, 295 expressed a preference for the metric system for commercial reasons, while 546 preferred our present system. For scientific reasons 410 favored the metric system and 364 were opposed. It is interesting to note that while 659 indicated that they had used the metric system to some extent, only 250 voted in favor of legislation to bring about its adoption in this country.

The statements above are given on the authority of the publicity service of the American Institute of Weights and Measures, 115 Broadway, New York City.

* * *

PROPOSED SIX-YEAR ENGINEERING COURSES

There is considerable discussion at the present time as to the advisability of a longer and more thorough education of engineers, and some of the engineering societies have placed themselves on record as favoring a six-year engineering course beyond the high school. At Columbia University, New York City, the engineering course in the engineering school is only three years, but not less than three years of college training, including special preparation in mathematics, chemistry, and physics, is required for admission. Besides the Columbia course, the only other engineering course that definitely requires six years is the mining engineering course at Leland Stanford University. Six years is a long period of training after high school, and before it becomes general, it is to be hoped that a very thorough study will be made of the actual requirements in engineering work, and that such studies as are found to be of only secondary value be eliminated before the courses are extended. Furthermore, full use should be made of the time available during the year, for the college year, as a rule, makes use of but a part of the actual time available. A few engineering schools have set a fine example in this respect in that the students are at work practically throughout the entire year, with little or no more vacation than is granted in ordinary commercial work.

* * *

THE GERMAN MACHINE TOOL INDUSTRY

At the annual meeting of the Society of German Machine Tool Manufacturers in Dresden, June 14, Mr. Reinecker reviewed the present conditions in the machine tool industry in Germany. He called attention to the fact that the industry had suffered considerably from the disturbances in the labor market and from the high prices of raw materials. Six hundred firms are now members of the society and plans are made for an exposition of machine tools at Leipzig during the latter part of August and early in September.

NEW MACHINERY AND TOOLS

THE COMPLETE MONTHLY RECORD OF NEW AMERICAN METAL-WORKING MACHINERY

Diamond Heavy Face Grinder. Diamond Machine Co., 9 Codding St., Providence, R. I. 1181
Van Norman Bore Grinder. Van Norman Machine Co., Springfield, Mass. 1183
Ney Draw-in Chuck. J. M. Ney Co., Hartford, Conn. 1184
Rouillard Planer and Shaper Tool-holder. Rouillard Tool Corporation, 608 Chestnut St., Philadelphia, Pa. 1185
Wetmore Cylinder Reaming Sets. Wetmore Reamer Co., Milwaukee, Wis. 1185
Keller Dial Test Indicator. Atcheson Tool & Die Co., 609-611 N. 4th St., Columbus, Ohio 1186
Drilling Machine. Frontier Machine Tool Co., Inc., 128 Lakeview Ave., Buffalo, N. Y. 1186
Purves Drilling Attachment for Milling Machines. Purves Mfg. Co., 408 S. Franklin St., Syracuse, N. Y. 1186
Miller "Anyangl" Lighting Fixture. Miller Saw-Trimmer Co., Pittsburg, Pa. 1187
"Natco" Inverted Drilling Machine. National Automatic Tool Co., Richmond, Ind. 1187
Hasler Integrating Tachometer. C. H. Boulin, 82 Duane St., New York City 1187
J. C. Glenzer Interchangeable Counterbore. J. C. Glenzer Co., Detroit, Mich. 1188
R. G. Smith Radius Tool. R. G. Smith Tool Works, 315 Market St., Newark, N. J. 1188
Ross Centrifugal Lubricant Pump. Ross Mfg. Co., 3160 W. 106th St., Cleveland, Ohio 1189
Newton Special Milling Machine. Newton Machine Tool Works, Inc., Philadelphia, Pa. 1189
Bryant Chucking Grinder. Bryant Chucking Grinder Co., Springfield, Vt. 1190
Betts Continuous Milling Machine. Betts Machine Co., 400 Blossom Road, Rochester, N. Y. 1190
C. F. Davis Keyseater. C. F. Davis Machine Co., Inc., 133 Andrews St., Rochester, N. Y. 1191
Gardner Abrasive Disk. Gardner Machine Co., Beloit, Wis. 1191
Rickert-Shafer Chaser Grinder. Rickert-Shafer Co., 612 W. 12th St., Erie, Pa. 1191
Oliver Motor-driven Surface Planer. Oliver Machinery Co., Grand Rapids, Mich. 1192

Diamond Heavy-Duty Face Grinder

This grinding machine is intended for heavy work ordinarily performed on planers or large millers. The general features of the design are similar to those of face grinders of this company's manufacture equipped with ring-wheels up to 30 inches in diameter. The present machine has a sectional type of wheel 54 inches in diameter, and all other dimensions of the machine have been correspondingly increased to give the desired capacity for handling large pieces of work.

FOR several years the Diamond Machine Co., 9 Codding St., Providence, R. I., has been building machines known as heavy face grinders, which have found successful application in handling certain classes of work that are ordinarily done by planing or milling machines. Until recently these heavy face grinders have been built with ring-wheels up to 30 inches in diameter. Acting upon suggestions from manufacturers who believe they have work that could be economically ground on a machine of this general design but of larger capacity, a face grinder constructed along the same lines has been built with a sectional type of wheel 54 inches in diameter, and it will be used in a machine tool building plant for grinding the bases of multiple-spindle drilling machines. Although most of the original principles of design of Diamond face grinders have been retained, the machine has been entirely remodeled to afford increased capacity and to give it the necessary strength and rigidity for the heavier stresses encountered in handling larger pieces of work.

It is believed that this new Diamond 54-inch face grinder is one of the largest grinding machines which has ever been built, and this fact will be readily substantiated by reference to the following dimensions: As previously mentioned, the wheel is 54 inches in diameter, and it is carried by a 9-inch spindle supported in adjustable bronze-bushed radial bearings and ball thrust bearings. The table is 36 inches wide by 9 feet long, with a travel of 11 feet, and the distance from the table surface to the top of the wheel is 48 inches, which gives capacity for grinding work 47 inches high. From the floor to the center line of spindle, the distance is 55 inches.

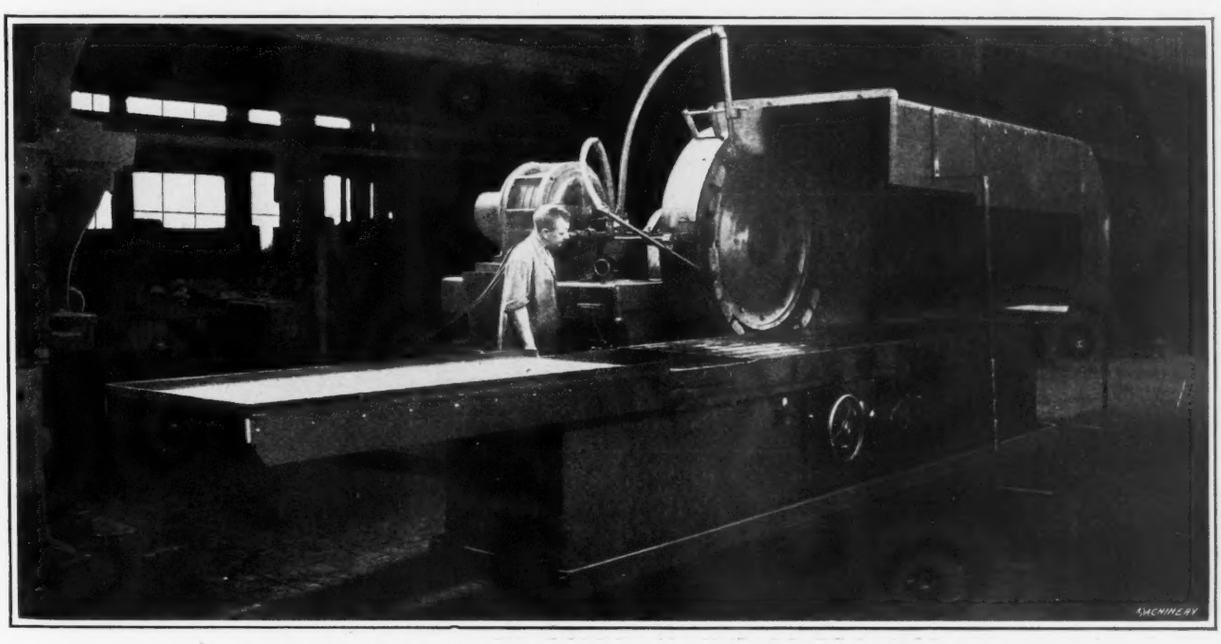


Fig. 1. Fifty-four-inch Heavy-duty Face Grinder built by the Diamond Machine Co.

One of the features of the new Diamond grinder is the provision which has been made for handling water and the means provided for effectually protecting all slides and other rubbing surfaces from damage. Reference to the rear view of the machine will make it apparent that there is a tank arranged to hold the necessary volume of water in such a way that there is a large surface area and only a moderate depth. This arrangement is the means of facilitating the settling of sediment, so that clear water can be returned to the circulating system. Behind the table at each side of the machine, there is also a long trough that catches the water from the wheel; and in addition, there is a trough which extends around the two ends and front of the machine at the floor level, and communicates through by-passes with the main water tank. A system of troughs inside of the bed carries water from the long troughs behind the table back to the water tank. It will be apparent from the illustration that water is carried up to the grinding wheel and the work by means of a belt-driven pump.

To those who are not familiar with the features of previous models of Diamond face grinders, it will be apparent from the illustrations that the present machine is arranged with a table that provides for reciprocating the work past the grinding wheel, and the wheel-head is mounted on a transverse slide to enable the wheel to be fed inward for grinding to the required depth. The maximum transverse feed movement is 5 inches and provision is made for moving the wheel-head either automatically or by hand. One of the new features of the present machine is an automatic feed-stop which may be set to provide for tripping the power feed when the grinding wheel has removed the desired depth of stock from the work.

In operating this grinder, the normal position for the attendant is as shown in Fig. 1, where he is able to observe the cutting action of the grinding wheel. However, it may happen that the operator wishes to go to the opposite side of the table while the machine is running, and it is desirable for him to have the machine under control while in that position. Consequently, two centralized sets of control wheels and levers have been provided, one of which is within reach of the normal operating position and one is at the front of the bed. The control mechanism at the front of the grinder includes a knob for manipulating the power-feed clutch, a lever for operating the table feed, another lever for manipulating the table reverse, and a handwheel for providing a hand-feed movement to the table; also, there is a lever governing the clutch on the main driving shaft. Located at

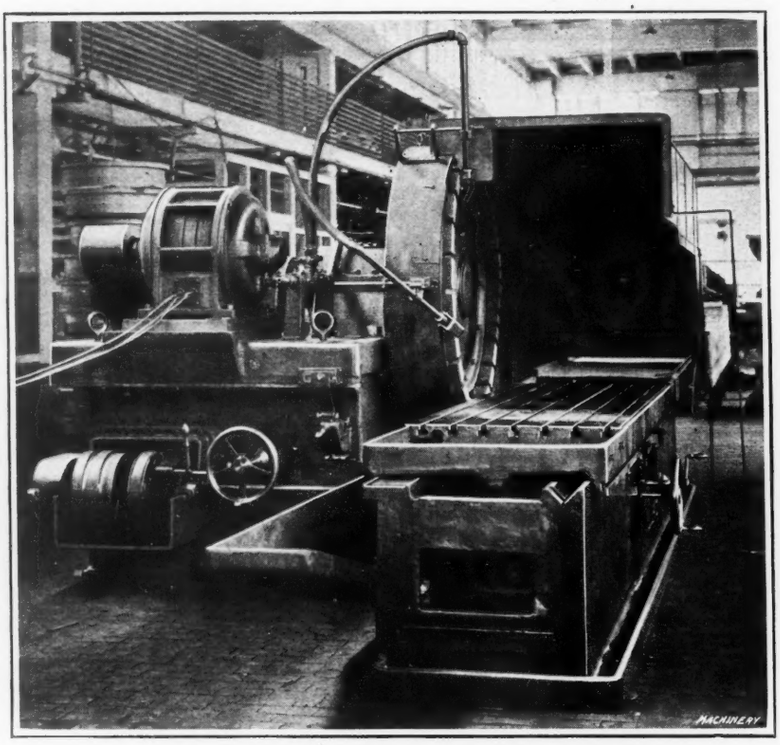


Fig. 3. End View of Diamond Face Grinder, showing Control Mechanism

what has been designated as the normal operating position, there are a feed-clutch lever, a table reverse lever, a wheel for obtaining hand feed for the grinding wheel head, an automatic depth stop for the table feed, and means for stopping the table travel at either end of its stroke.

Normally, a grinding machine of this type will be operated for considerable periods of time on a single class of work, and it is not necessary to change the rate at which the work is reciprocated past the grinding wheel, but provision has been made by the designers for obtaining four rates of table travel. This is accomplished by having a pair of change-gears contained in a case at the back of the machine, which can be removed from their studs to allow a new pair of gears to be substituted. By making such changes, speeds of 12, 17.33, 22.66, and 28 feet per minute are obtainable. The grinding wheel head feeds into the work at each reversal of the table, that is to say, there are two feed movements of the wheel-head for each complete forward and return movement of the table. This feeding of the wheel-head is accomplished by means of a cam-actuated pawl which engages the teeth of a ratchet wheel mounted on the feed-screw. The handwheel which adjusts this feed mechanism to govern the amount of feed that is imparted to the grinding wheel at each reversal of the direction of table travel is furnished with two graduated dials, one of which indicates the amount of feed that will be obtained for any given position of the adjusting wheel, while the other dial shows the total amount of metal removed from the work for any given position of the grinding wheel head. The feed mechanism furnished on the machine provides for obtaining feeds of from 0.002 to 0.020 inch per stroke of the table.

In conclusion, attention is called to the arrangement of guards at either end of the table, which project out far enough so that the ways are always covered regardless of the position of the table. Consequently, it is highly improbable that water, grit, or other foreign material will find its way into the bearings and cause them to become scored or rapidly worn. Another important feature of this grinder, from an operating standpoint, is

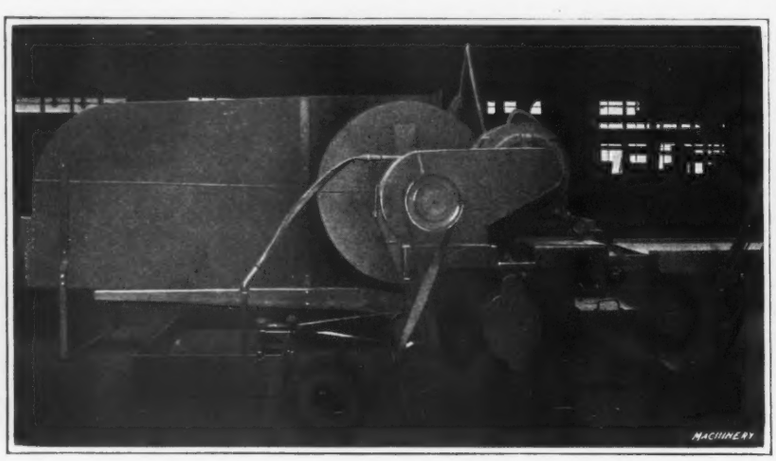


Fig. 2. Rear View of the Diamond Heavy-duty Face Grinder, showing Water Troughs, Motor Drive, etc.

the provision of conveniently located oil-holes around the frame of the machine, which are covered by pivoted plates conspicuously marked with the word "oil." From each of these holes an individual tube leads to one of the important bearings of the grinder; and with such an arrangement as this, it is so simple for the operator to oil the bearings on his machine that there would appear to be very little excuse for overlooking any of the parts of the mechanism that require the supply of lubricant to be replenished at specified intervals. Power for driving the machine is furnished by a 40-horse-power electric motor.

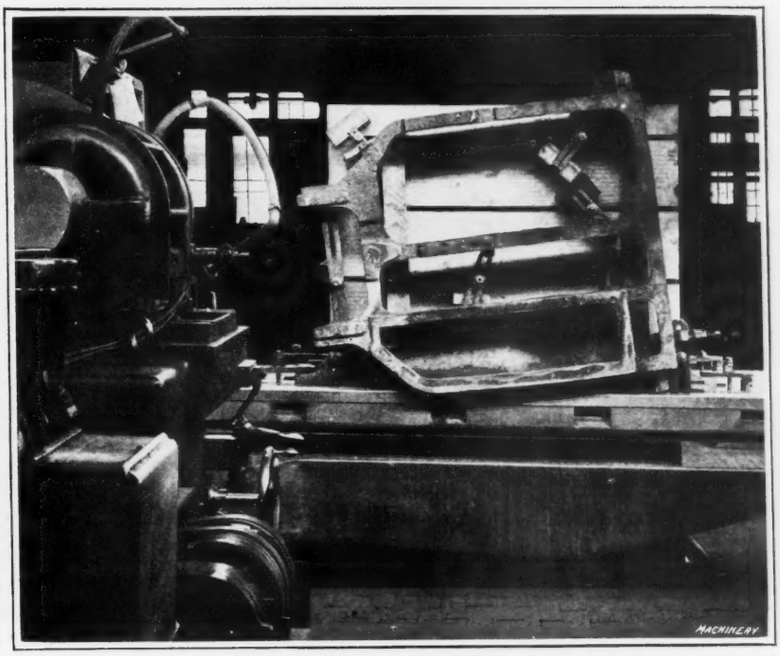


Fig. 4. Close-up View of a Casting set up on the Machine for grinding

VAN NORMAN BORE GRINDER

The Van Norman Machine Co., Springfield, Mass., has recently placed on the market a No. 9 bore grinding machine which is adapted both for small work and for larger work up to 20 inches swing; that is, a work-holding fixture of 20 inches diameter may be used with the head set to hold the work in alignment with the grinding wheel quill. The machine is equipped with the standard Van Norman type of sliding head, and resembles somewhat the No. 34 machine of this company's make. The provision for grinding large-diameter work includes a deep gap in the machine body. Reference to Fig. 1, which is a front view of the bore grinder, will enable this feature in the construction of the frame to be seen, while Fig. 3 illustrates the capacity of the machine for large-diameter work. This underslung construction of the frame of the machine, together with its compactness and rigidity, are noteworthy features of construction. The design of the base offers a unique method of motor installation; the motor is housed in the frame and is enclosed by a door in front. The advantage of this location for the motor will be apparent by inspecting Fig. 2, which shows a rear view of the machine and the short direct belting used in the drive. This arrangement reduces the space required and adds to the compactness of the machine.

The Work-spindle Head and the Grinding-wheel Quill

The construction of the work-head is illustrated in Fig. 4. The spindle is mounted in double sets of ball bearings, each pair being separated by a spacing collar which enables the correct adjustment to be obtained when mounting the spindle in the head. This is accomplished by grinding the face of the outer collar to take up the end play of the spindle. The rear bearings are floating in the work-head, and the inner raceways are held in a fixed position relative to the front bearings by a sleeve which runs in oil, distributing it from wipers *A* to the rear pair of ball bearings by an oil-tube, and to the other pair from the deep oil-groove *B*. The oil-well in which the spindle sleeve runs is provided with a window so that the supply of oil can be instantly seen.

The construction of the grinding-wheel quill is illustrated in Fig. 5, from which it will be seen that it is mounted on ball bearings similar to the mounting of the work-spindle. As in the case of the work-head, an oil reservoir with sight window provides a plentiful lubricant supply for the bearings of the quill spindle. It will be noted, in both the spindle head design and in the quill mounting, that the cap which encloses the ball bearings is provided with dirt grooves to safeguard the running condition of the ball bearings.

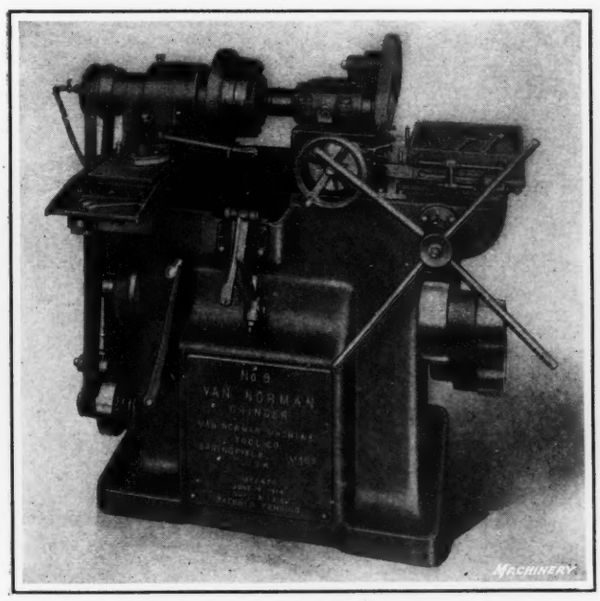


Fig. 1. Front View of Van Norman No. 9 Bore Grinder

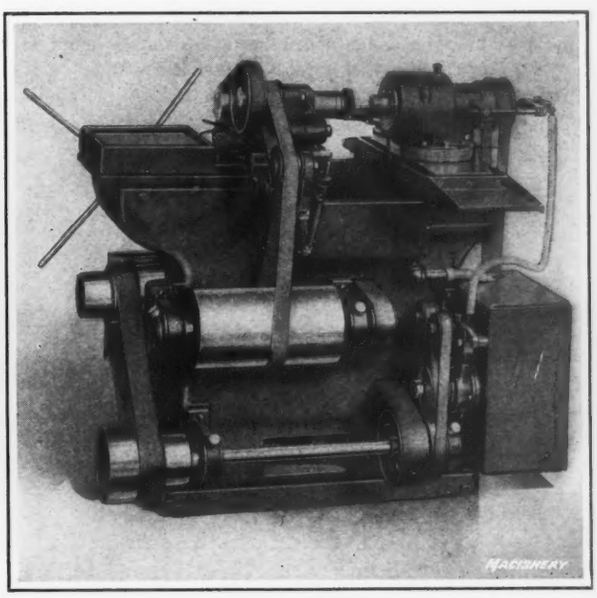


Fig. 2. Rear View, showing Pulleys belted through Frame

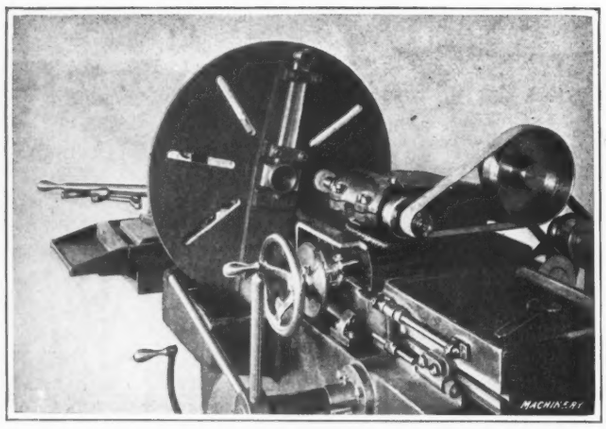


Fig. 3. Work-spindle in Offset Position carrying Large-diameter Work-holding Fixture

Operating Features of Machine

The No. 9 bore grinder is a hand-operated machine as regards traverse of the wheel-slide, but is provided with automatic cross-feed with graduated dial. The regular Van Norman work-spindle slide is operated by a hand-lever shown in Fig. 1, which permits the head to be slid out of alignment with the wheel-spindle when removing or gaging the work, the grinding wheel only having to be withdrawn a short distance from the end of the work. A self-acting brake mechanism stops the rotation of the work-spindle when the slide is drawn into an offset position. All operating levers have been arranged so that it is not necessary for the grinder to change his position during the grinding operation. The safety from physical injury with which the operator can test or remove the work when the head is in the offset position is a notable feature.

There is a sector-shaped plate carried on the work-head slide which has a T-slot in which a stop is fastened for the purpose of enabling the operator to bring the center line of the work-head in line with that of the grinding wheel. By employing two of these stops in the T-slot, to limit the swing of the operating lever in either direction, the grinding of work having two diameters of holes and an interior shoulder may be greatly facilitated. In grinding work of this kind, where it is desired to face-grind either the interior shoulder or outside edge of the work, a cup-wheel is used. One slide stop is then set, locating the work-head transversely for grinding the small-diameter hole, and the wheel-carriage stop is set to bring the end of the grinding wheel into position for facing the interior surface, when the carriage is brought back against the stop. Then by employing a second stop in the T-slot of the work-head slide, and by throwing stop *A* up out of engagement, the operating lever of the slide may be swung into engagement with the second stop, thus locating the work in the proper position for grinding the large-diameter hole. It will be seen that by locating the second stop to bring the work into the position necessary for grinding the larger diameter, the three interior surfaces will be ground at one setting.

The wheel dresser is attached to the box section on the frame as shown in Fig. 1 so as not to interfere with the operator, and can be swung into position when desired. Fig. 2 shows the position of the coolant supply tank and its connection to the spindle, and to the drip box from which the fluid drains into the supply box. A centrifugal pump is shown attached to the coolant box for pumping the liquid to the work. The drum and pulley shafts are mounted in self-aligning ball bearings. The cone pulley provides three grinding wheel speeds, as determined by the size of quill pulley with which the machine is equipped. Quill pulleys of recommended size for the particular work being ground are furnished with the machine, if so desired.

When the machine is equipped with a wheel dresser, it has a capacity for grinding holes to a depth of 4½ inches; when the dresser is not attached, the depth of hole capacity is 6 inches. The maximum diameter of work-holding fixture permissible when the head is not set at an angle is 20 inches. The maximum forward movement of the work-slide is 8 inches. The work-head is graduated 30 degrees each side

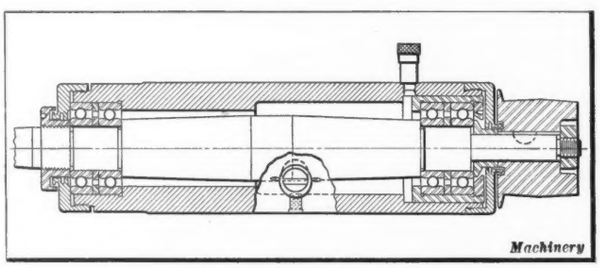


Fig. 5. Ball-bearing Mounted Quill Spindle for Van Norman No. 9 Grinder

of the center for convenience in grinding tapered work. Six work-spindle speeds are provided, ranging from 72 to 431 revolutions per minute, in geometrical progression. The regular grinding spindle speeds, using quill spindles and pulleys of recommended size, range from 3400 to 19,000 revolutions per minute, depending upon the diameter of work being ground. The machine is belt-driven throughout, no gears or chains being used. The distance above the floor to the center of the head-spindle is 43 inches; the floor space required is 39 by 63 inches. A constant-speed 3-horsepower electric motor, running at 1200 revolutions per minute, is considered standard construction. Regular equipment includes one standard wheel quill to suit the work, and pump and water attachments for wet grinding. The net weight of the machine is 2950 pounds; boxed, 3500 pounds.

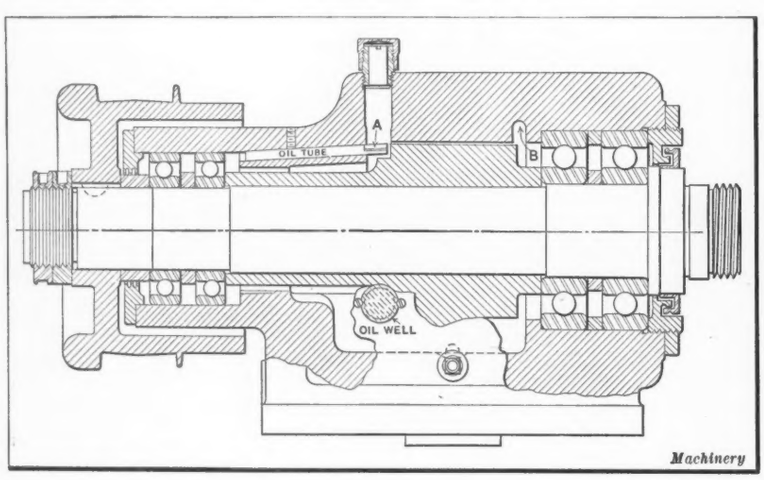


Fig. 4. Cross-section of Work-spindle, illustrating Spindle Mounting and Oiling System

NEY DRAW-IN CHUCK

The draw-in collet chuck shown in Fig. 1 has recently been placed on the market by the J. M. Ney Co., of Hartford, Conn. The long tube and handwheel which is ordinarily employed on a lathe spindle for operating a draw-in type of chuck is not used with these chucks. One of the outstanding features of this chuck is the fact that it is quite hollow and leaves the entire opening in a lathe spindle free from obstructions. When doing lathe work or performing milling operations on a long broach or similar work, it is possible to feed the work out of the chuck as the machining operation progresses. This feature makes the chuck well adapted for performing certain operations on both hand and automatic screw machines.

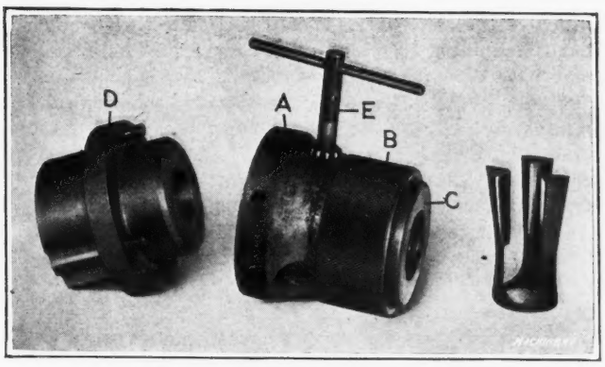


Fig. 1. Draw-in Chuck made by the J. M. Ney Co., and Collets of Various Sizes used in the Chuck

It is claimed that the chuck is equally well adapted for use on milling machines, grinders, or drilling machines. Its regular adaptation to the lathe is illustrated in Fig. 2. Each chuck is furnished with six collets ranging in size from ⅜ to 1 inch, and each collet may be used on work 1/32 inch over or under the nominal size. Referring to Fig. 1, the chuck consists of a body *A*, a knurled sleeve *B*, a nose-piece *C*, an adapter *D*, and a pinion key *E*. The nose-piece is threaded on the outside to fit the internal threads of the sleeve. By turning the sleeve, a longitudinal movement of the nose-piece is obtained, the nose-piece being prevented from rotating by a key located in the body. This longitudinal travel brings the nose-piece against the collet, causing it to draw in by being forced into the round cone-shaped opening within the body, which fits a similar conical shape on the outside of the collet. With this arrangement, adequate tightening pressure is obtained through the gear teeth on the sleeve and the pinion key *E*.

The longitudinal thrust which is imparted to the sleeve is taken up by a row of twenty-six ball bearings which insure easy operation of the chuck at all times. The collets are readily accessible, and can be changed by turning the sleeve until the nose-piece can be removed. The body and other members are made of machine steel, pack-hardened and accurately ground on all working surfaces. The collets are made of tool steel and are accurately ground. The adapter *D*, which is of cast iron, is furnished in a semi-rough condition. It has three drilled and counterbored holes properly spaced to correspond with three tapped holes in body *A*. There are also three tapped holes in the rim of the adapter into which screws may be put if it becomes necessary to remove the adapter from the body.

The portion of the adapter which enters the body is purposely furnished considerably larger than the hole in the rear of the body to insure perfect concentricity of the chuck when it is fitted to the machine on which it is to be used. In adapting the chuck for use on a lathe, it is customary to place the adapter in a chuck and thread it to fit the spindle of the lathe. After this operation has been accomplished, it is only necessary to screw the adapter on the nose of the lathe and turn the front end to a snug fit for the hole in the body. An interesting test of the holding qualities and rigidity of the chuck is illustrated in Fig. 2, where a 1-inch cold-rolled bar protruding 5½ inches from the face of the chuck was reduced to ½ inch in diameter using a 1/32-inch feed, without apparent spring of the chuck or work.

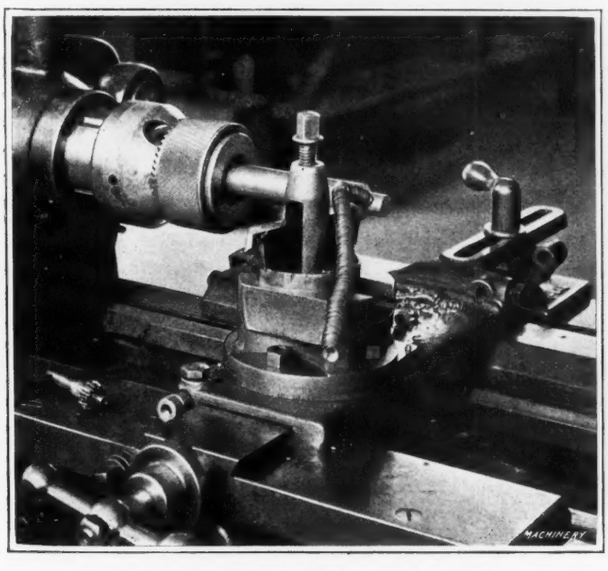
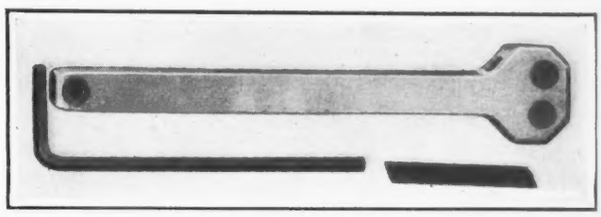


Fig. 2. Ney Draw-in Chuck mounted on Lathe

ROUILLARD PLANER AND SHAPER TOOL-HOLDER

The Rouillard Tool Corporation, 608 Chestnut St., Philadelphia, Pa., has recently brought out the double-ended tool-holder shown in the accompanying illustration. No rake angle is provided for the tools at either end of this holder. On one end the tool slot is parallel with the body of the holder, thus providing a suitable holder for use in planing flat surfaces. The other end has two slots at opposite angles with separate set-screws for each. With this arrangement of tool slots, it is possible to perform almost any kind of planing operation without removing the holder from the toolpost. These holders are furnished with one tool bit and a wrench for the headless set-screws, and they can be obtained in seven sizes. They are made of drop-forgings and are pack-hardened.



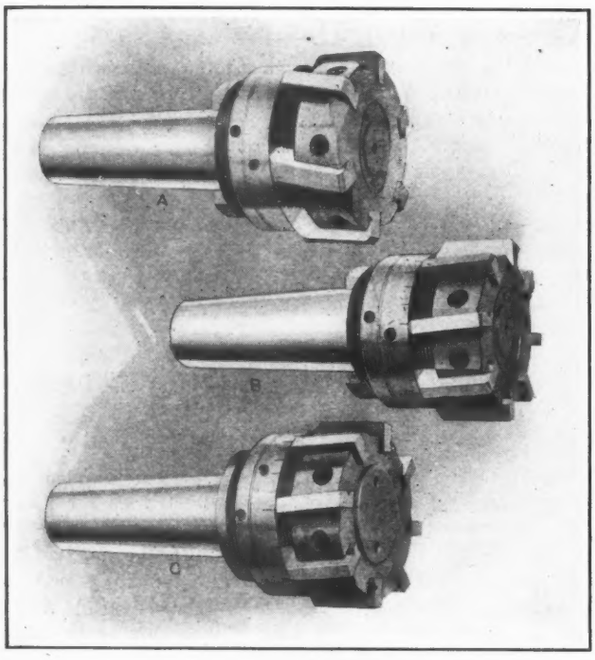
Double-ended Tool-holder made by the Rouillard Tool Corporation

WETMORE CYLINDER REAMING SETS

A new cylinder reaming set has been added to the line of reamers made by the Wetmore Reamer Co., Milwaukee, Wis. This set, which is shown in the accompanying illustration, consists of three tools: A roughing reamer, a semi-finishing reamer, and a floating finishing reamer. This set of tools has been designed for the purpose of producing as nearly as possible holes which are round, straight, and smooth. The roughing reamer shown at *A* is of heavy construction, and is intended to withstand the strains imposed by the initial reaming operation. It is equipped with adjustable blades set at a right-hand angle, and provision is made for replacing the blades when worn.

The semi-finishing tool shown at *B* has blades set at a left-hand angle, similar to the standard Wetmore floating reamer. The purpose of setting the blades in this manner is to eliminate the liability of digging in and chattering, so that a free, round hole that is not scored when backing out will be produced. It may be stated here that a modification of this reamer is made for line and pilot reaming.

The floating finishing reamer shown at *C* has the parts which give the reamer its floating action incorporated in the head of the tool at the point directly under the strain which the floating action is intended to counteract. It is claimed that this feature eliminates all tendency of the reamer to get out of parallel or to cramp. The floating action is obtained through the use of an improved type of Oldham coupling having rollers instead of sliding contacts to reduce friction. The floating mechanism is protected from dust and grit by a cap at the front of the tool and a washer which

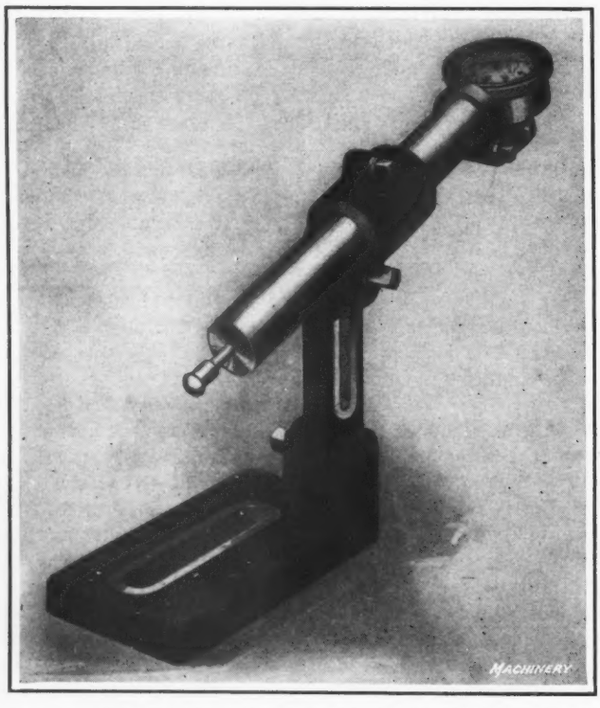


Set of Cylinder Reamers made by the Wetmore Reamer Co.

protects the back. Both the semi-finishing reamer and the finishing reamer can be adjusted to thousandths of an inch by means of a graduated micrometer lock-nut located at the rear of the blades. At present, these sets can be furnished in sizes varying from 2 7/16 to 5 9/16 inches in diameter.

KELLER DIAL TEST INDICATOR

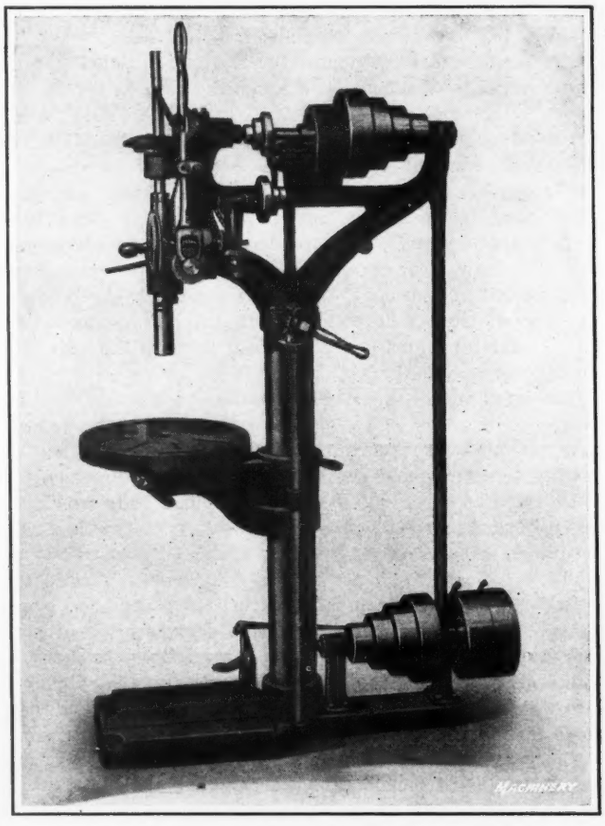
The indicator shown in the accompanying illustration is a recent product of the Atcheson Tool & Die Co., 609-611 N. 4th St., Columbus, Ohio. This indicator is designed to meet the requirements of a wide range of work, and is especially adapted for gaging cylindrical work while it is being rotated. Referring to the illustration, it will be seen that the dial indicator is mounted at the end of a mandrel fitted in a split bushing. The indicator pin extends through this mandrel and is provided with a hardened and polished tip which rests on the work. It will be seen that the split bushing is connected to a slotted base by an adjusting link, so that it is a simple matter to locate the indicator in any desired position. The dial is especially designed for easy reading, and is graduated in thousandths. Some of the advantages claimed for this indicator are that it requires no great skill to obtain the most accurate results, that it takes a wide range of work, eliminates the time lost in stopping the machine to measure the work and that the contact point is more sensitive than the human sense of touch.



Keller Indicator made by the Atcheson Tool & Die Co.

FRONTIER DRILLING MACHINE

The vertical drilling machine shown in the accompanying illustration is made by the Frontier Machine Tool Co., Inc., 128 Lakeview Ave., Buffalo, N. Y. This machine has been especially designed to meet the requirements of high-speed production. The most notable feature is the double column which is intended to resist the heavy pressure applied by the spindle. All controlling levers have been designed and located with a view to making the machine easy to operate.

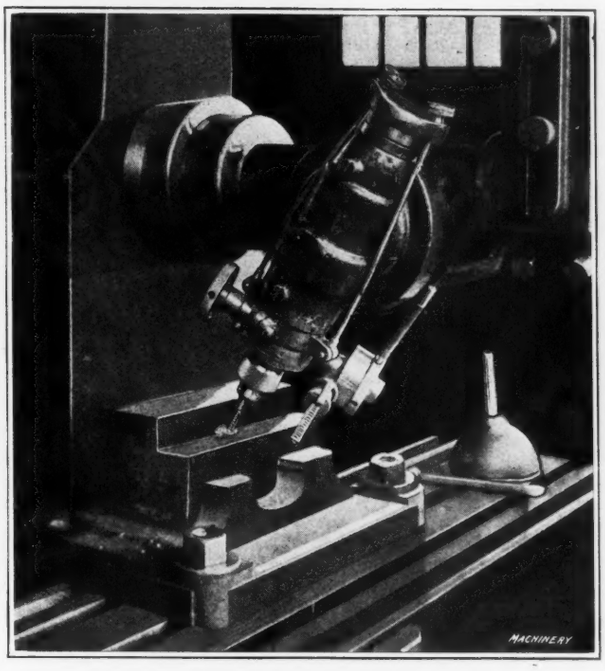


Drilling Machine made by the Frontier Machine Tool Co.

PURVES DRILLING ATTACHMENT FOR MILLING MACHINES

The milling machine attachment shown in the accompanying illustration is made by the Purves Mfg. Co., 408 S. Franklin St., Syracuse, N. Y. With this attachment holes can be drilled at any angle varying from vertical to horizontal. In order to drill a hole at any desired angle, it is only necessary to place the work flat on the table, and throw the vertical head to the desired position; then attach the device and proceed as when drilling a vertical hole.

Practically the only difference in the drilling operation is that the drill is fed into the material with a small handlever which is part of the attachment. The feeding attachment is movable, so that it can be changed in case it interferes with any part of the work being drilled. The depth



Angle-drilling Attachment made by the Purves Mfg. Co., shown in Position on Milling Machine

of the holes can be controlled by a stop, which when once set, permits the drill to penetrate to the required depth but no further. Hence, the device enables the operator to drill a number of horizontal holes of the same depth.

MILLER "ANYANGL" LIGHTING FIXTURE

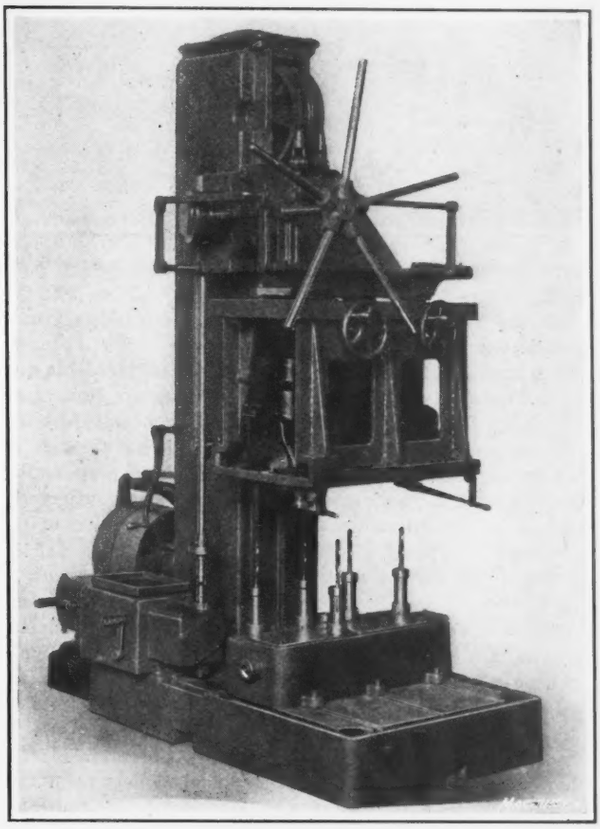
The "Anyangl" lighting fixture shown in the accompanying illustration is made by the Miller Saw-Trimmer Co., Pittsburg, Pa. This fixture is designed especially for attachment to lathes, planers, shapers, millers, and similar machines that require proper distribution of light in order to insure speed, accuracy, and safety of operation. The lamp with its reflector and protecting cage can be swung through a complete circle, either vertically or horizontally. This feature of universal adjustment permits the light to be projected in any direction or concentrated where needed. A simple twist of the thumb-screw at the joint which connects the extension arm to the supporting rod securely locks the lamp in position where it cannot be loosened by vibration.



"Anyangl" Lighting Fixture attached to Shaper

"NATCO" INVERTED DRILLING MACHINE

In the bottom of the Studebaker cylinder block, there are five holes to be drilled, which are 9/16 inch in diameter by 4¾ inches deep. Experience has shown that the drilling of such holes is likely to prove a troublesome operation, owing to the necessity of backing the drills out a number of times in order to clear the chips which have a tendency to clog in the drills. To overcome this difficulty and to provide for simultaneously drilling the five holes, the National Automatic Tool Co., Richmond, Ind., designed a No. 85 "Natco" inverted multiple-spindle drilling machine, which has the drills held in adjustable spindles located under the work. The cylinder block to be drilled is placed in a fixture supported on the table which feeds downward when the operation is performed. Under such conditions, the chips fall out of the holes by gravity, making it unnecessary to back the drills out of the holes until they have reached the desired



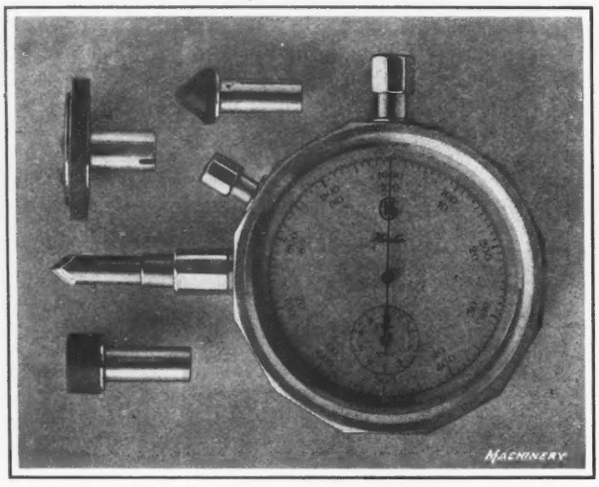
Inverted Multiple-spindle Drilling Machine built by the National Automatic Tool Co.

depth. The work is located in the fixture by means of two disappearing dowel-pins which are controlled by a lever at the bottom of the fixture. After being located, two handwheels at the top of the fixture are rotated to tighten up a clamping mechanism that forces the work down on a bushing plate at the bottom of the fixture.

HASLER INTEGRATING TACHOMETER

In the accompanying illustration there is shown an instrument known as the Hasler integrating tachometer, because it counts the speed over a period of three seconds and then "integrates" the result to give the desired information in terms of revolutions per minute or yards per minute. In using this instrument, no watch is needed, as the timing is obtained automatically. Attention is called to the fact that the danger of an error in using a watch is eliminated. In using this instrument, the operator is merely required to press a large button after connection has been made with the machine. This requires no mental concentration and en-

ables the operator to devote his undivided attention to maintaining contact between the instrument and the machine. Once the contact is made with a shaft, the spindle of the instrument runs freely until the large button is pressed down and released. This makes direct connection with the hands on the dial. After running for three seconds the spindle is automatically freed while the hands remain in the reading position; and after the reading has been taken, the



Hasler Integrating Tachometer for which C. H. Boulin has the Sales Agency

hands may be instantly brought back to zero by pushing a small button.

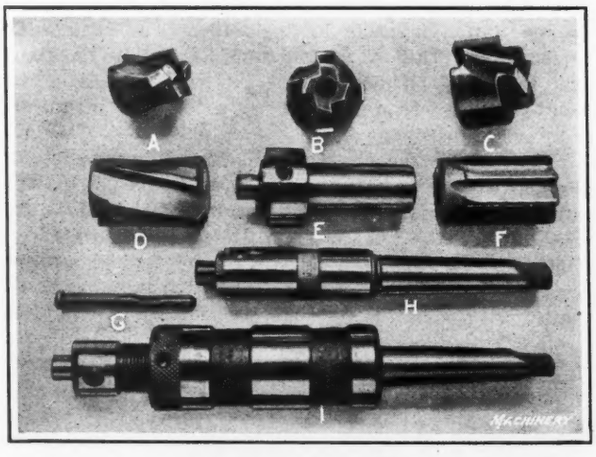
When it is required to take two or more readings, this may be done without pushing the small button, the last result being added to the first. If several measurements are taken in succession, the total result obtained automatically is divided by the number of readings to show the average speed. Naturally, such a practice would be followed only where the speeds of all machines are uniform. The operation of the instrument is entirely mechanical and it is not affected by magnetism, gravity, or centrifugal force. The clockwork is made by French and Swiss mechanics and is said to be entirely independent of temperature changes. The instrument is packed in a case, which also contains three different types of rubber connections, but which is small enough to be put in an ordinary pocket. The instrument is made of aluminum so that it weighs only 10 ounces. This tachometer can be operated in any position either vertical, horizontal, or at any angle, and it has a large speed range, namely from 1 to 10,000 revolutions per minute. The long hand indicates speeds from zero to 1000 revolutions per minute and the short hand, running over a separate dial, counts the number of thousands. By carefully noting the number of revolutions made by the small hand, speeds in excess of 10,000 revolutions per minute can be determined. Either revolutions per minute or yards per minute may be read directly on the dial without requiring any mathematical calculations, both the large and small dials having a second set of graduations in red to indicate speeds in yards per minute. This instrument is sold by C. H. Boulin, 82 Duane St., New York City.

J. C. GLENZER INTERCHANGEABLE COUNTERBORE

The interchangeable counterbores shown in the accompanying illustration are manufactured by the J. C. Glenzer Co., Detroit, Mich., and are sold by C. H. Westerberg & Co., Inc., 9-11 West Broadway, New York City. With the exception of the tool shown at *H*, which is similar to one described in the May, 1918, number of MACHINERY, these tools represent entirely new developments of the J. C. Glenzer Co. Referring to the illustration, it will be seen that the construction of these interchangeable tools is simple. A complete tool consists of only four separate parts, the pilot (which is not shown), a pin, cutter, and holder. The parts were designed to give as nearly as possible the strength of a solid tool with the advantages of the interchangeable feature.

The pilot is of cold-rolled steel, hardened and ground, and made in the form of a bushing with notches at one end into which the teeth of the cutter fit, insuring a positive drive. The pilot is brought down to fit over the cutter teeth and below the cutting edge of the cutter, thus preventing burring in the hole—a condition which usually causes the pilot to stick or break. The pilot is self-centering with reference to the cutter teeth, and is made 0.005 inch under size up to sizes ¾ inch in diameter, and 0.008 inch under size for diameters over ¾ inch. When cored holes are to be counterbored, a core drill, driven in the same manner as the pilot, may be substituted for the pilot, thus eliminating one operation, as both core-drilling and counterboring will be accomplished simultaneously. The pins, one of which is shown at *G*, are made of 3.5 per cent nickel steel, and are accurately ground. The tapered flat at one side forms a bearing for the set-screw and serves to tighten the parts. The pins carry no strain and simply hold the parts together. The cutters are made of the highest grade high-speed steel, and are ground, hardened, relieved, and slotted to receive the lug in the holder, which gives a positive drive. The regrinding of a cutter is a simple operation, and may be repeated until the cutter is nearly all used.

The cutter shown in the accompanying illustration at *A* is designed to counterbore and countersink a valve set at one operation. The cutter shown at *B* is employed in making dies for bottle caps, and that shown at *C* is designed to face, groove, countersink, and counterbore nuts at one operation. The holder shown at *E* is designed for screw machine work, and is adapted for holding any of the various cutters shown in the illustration. At *I* is shown a holder



"Utility" Interchangeable Cutters and Cutter-holders manufactured by the J. C. Glenzer Co.

for a multiple-spindle drilling machine. This is especially designed for use on machines which have no spindle adjustment to compensate for uneven wear of the tools; for instance, it permits a new cutter to be used on a multiple-spindle press in conjunction with ground down cutters. This holder is threaded on an outer sleeve to provide for adjustment, the position being fixed by a lock-nut. The reamer and core drill shown at *F* and *D*, respectively, are interchangeable and are typical examples of the type of tools generally used with the holders.

R. G. SMITH RADIUS TOOL

To meet the requirements of shops which desire to perform concave and convex radius turning operations in a lathe, shaper, or planer, the R. G. Smith Tool Works, 315 Market St., Newark, N. J., has developed a tool-holder that is regularly furnished with a set of cutters made in sizes

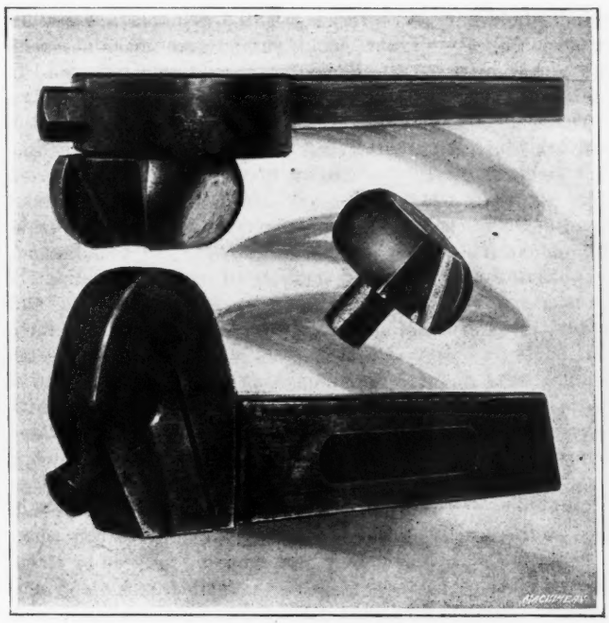


Fig. 1. Tool-holder made by the R. G. Smith Tool Works for performing Radius Work on a Lathe, Planer, or Shaper

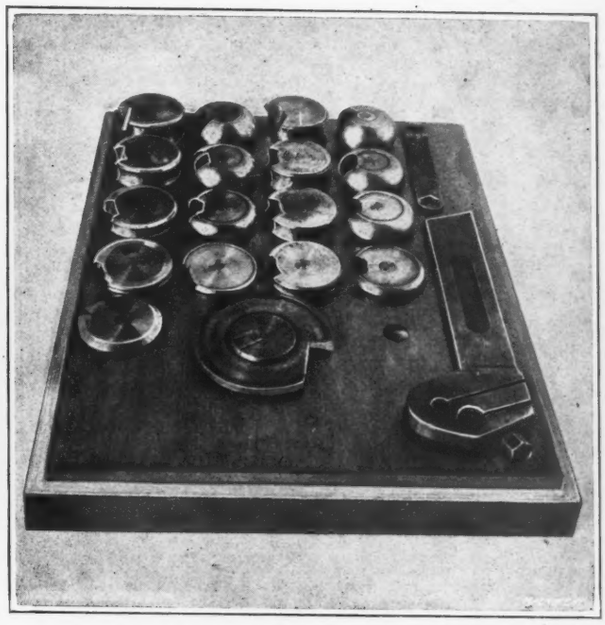


Fig. 2. R. G. Smith Radius Tool-holder and the Complete Set of Convex and Concave Cutters, Thread Tool and Cutting-off Tool

for handling work on which the diameter of the circle, of which the radius forms a part, covers a range of from ⅛ to 1 inch in diameter by intervals of 1/16 inch. It will be seen that these cutting tools are of circular form with the cutting edge produced by removing a segment from the tool. There is a small shank on one side that enters an opening in the tool-holder, where it is clamped by a set-screw; both the upper and lower cutting edges are ground, so it is possible to enter the shank in the holder opening from either one side or the other, thus providing for the use of both of the cutting edges. In addition to the radius-turning tools, this tool-holder set is furnished with a cutting-off tool and a tool for turning 60-degree threads. Other special cutters or cutters of other than the standard sizes could be furnished.

ROSS CENTRIFUGAL LUBRICANT PUMP

For delivering the lubricant or coolant to the cutting tools and work on various types of machine tools, the Ross Mfg. Co., 3160 W. 106th St., Cleveland, Ohio, has developed a centrifugal pump which is here illustrated and described. Fig. 1 shows the pump mechanism in detail, and in Fig. 2 the pump is shown set up on a machine ready for operation. From these illustrations it will be evident that driving is accomplished by a pulley which has an internal gear cut on the inside of its rim. This gear meshes with a pinion on the pump shaft. The arrangement of the intake and delivery pipes is apparent from the illustrations.

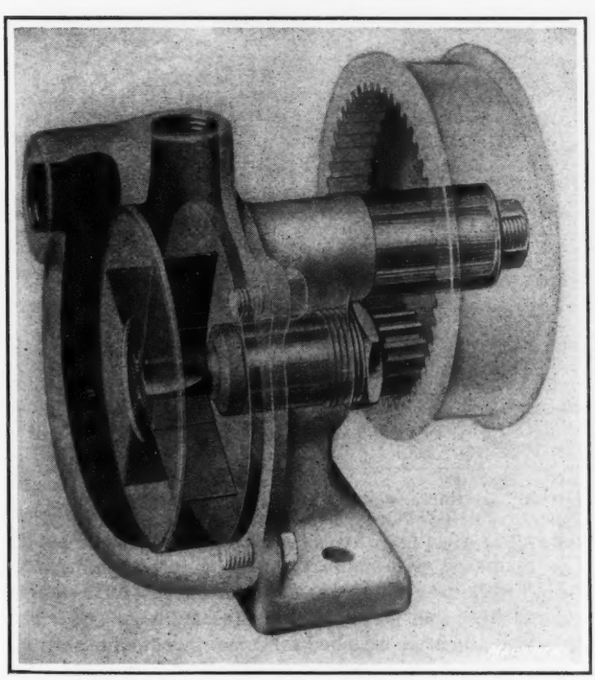


Fig. 1. Centrifugal Lubricant Pump made by the Ross Mfg. Co.

NEWTON SPECIAL MILLING MACHINE

The special milling machine shown in the accompanying illustration was designed and built by the Newton Machine Tool Works, Inc., Philadelphia, Pa., for use in the General Electric Co.'s plant at Fort Wayne, Ind. This machine was designed especially for milling the slots in motor rotors. The dimensions and specifications of the machine are: Diameter of spindle, 5 inches; vertical feed to spindle saddle, 24 inches; maximum distance from center of spindle to top of table, 28 inches; side adjustment to spindle, 2 inches; distance from center of spindle to face of upright slide, approximately 12 inches; size of table, 54 inches by 8 feet; and longitudinal adjustment of table obtained by hand feed, 24 inches.

The spindle of the machine is driven by a phosphor-bronze worm-wheel and hardened steel worm having roller end-thrust bearings. It is fully enclosed and runs in oil. An outboard support is pro-

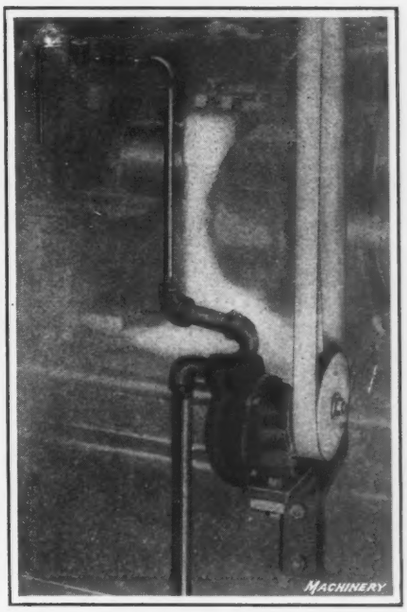
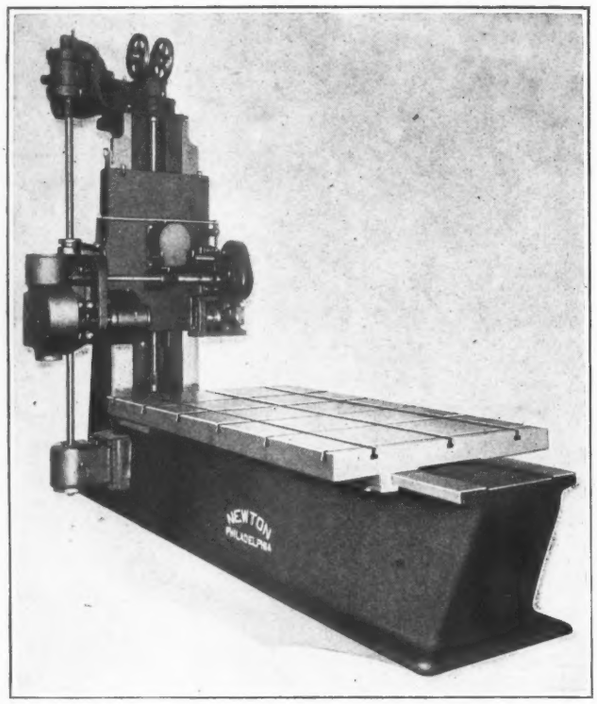


Fig. 2. Application of the Ross Centrifugal Lubricant Pump

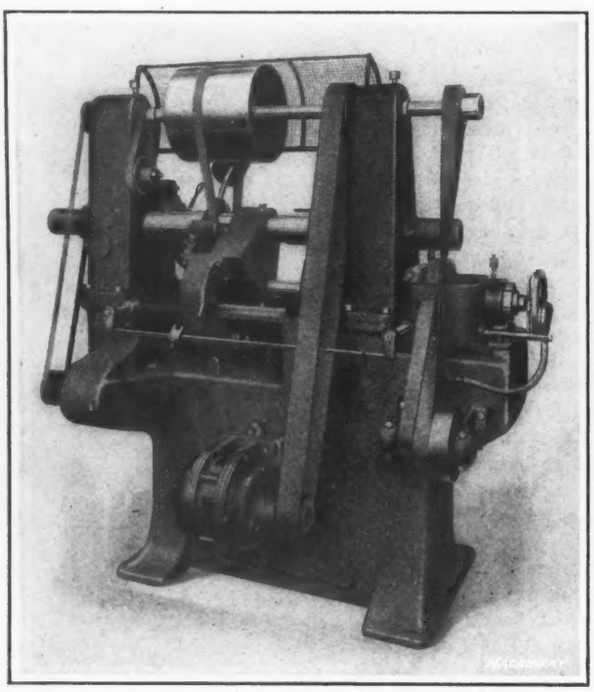


Special Milling Machine built by the Newton Machine Tool Works, Inc.

vided for the arbor, and the design is such that the arbor can be readily removed from the spindle. The spindle saddle has two vertical feeds operating through pick-off change-gears. An automatic stop is provided for the feed motion, which is so designed that the spindle stops rotating when the feed is thrown out. The spindle saddle is counterweighted and has power rapid traverse both up and down, a safety feed stop being provided to prevent damaging the cutters or work in case the rapid traverse gears are accidentally thrown in.

BRYANT CHUCKING GRINDER

The Bryant Chucking Grinder Co., Springfield, Vt., has recently brought out a self-contained grinder which is furnished in two types: A single-spindle hole grinder and a two-spindle hole and face grinder. These grinders are similar in design to the Bryant countershaft-driven machines with the exception that certain modifications have been made in their design which particularly adapts them for motor drive.



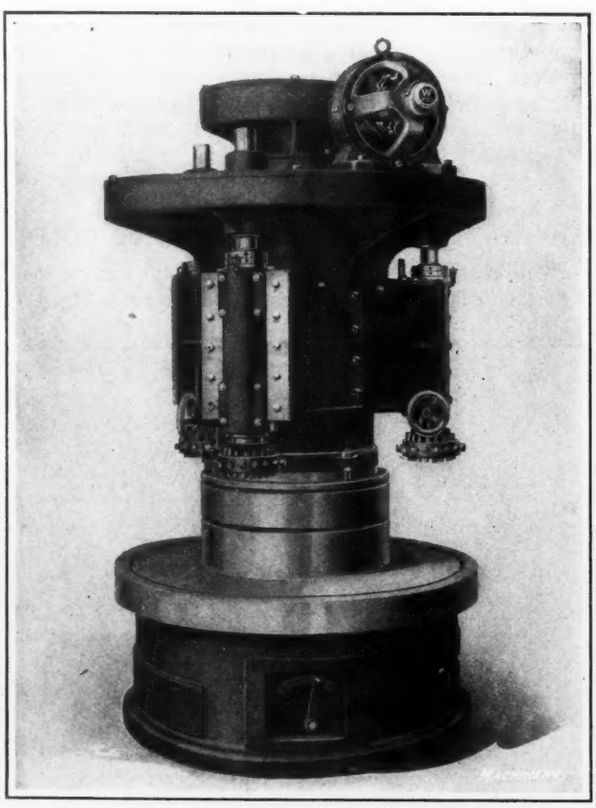
No. 15 Single-spindle Chucking Grinder made by the Bryant Chucking Grinder Co.

The No. 15 single-spindle grinder is shown in the accompanying illustration with the motor attached. This machine will swing work 12⅝ inches in diameter and has a wheel-slide traverse of 11¼ inches. The work-spindle is mounted in adjustable bronze bearings. The front bearing is 3 inches in diameter, the rear bearing 2½ inches, and the distance between the outer faces of these bearings is approximately 17 inches. There are two speeds for the work-spindle and two traverse speeds for the wheel-slide which are instantly obtainable by means of a lever. A graduated plate indicates angular adjustment for grinding tapers from zero up to a 30-degree included angle. The wheel-spindle drive shafts are mounted in ball bearings of the enclosed type. The water pump and piping are arranged to carry water to the work through the hollow work-spindle.

All pulleys and rotating members are given a dynamic balance at the speeds at which they are intended to run when in operation. A 3-horsepower motor having a speed of about 1720 revolutions per minute is recommended, and a 4½-inch diameter pulley is furnished with motors of this speed, which gives the main shaft the required speed of 1075 revolutions per minute. If slower speed motors are used, special sized drive pulleys must, of course, be provided.

BETTS CONTINUOUS MILLING MACHINE

The Betts Machine Co., 400 Blossom Road, Rochester, N.Y., is now building a multiple-spindle continuous vertical milling machine which is here illustrated and described. This equipment is usually provided with three spindles but it can be furnished with more spindles to meet the requirements of work where such a modification of the design is considered desirable. The machine is of simple and rigid construction and it is intended for heavy production milling on duplicate parts. The spindles are made of hammered steel and they are driven through long splines and spur gears.



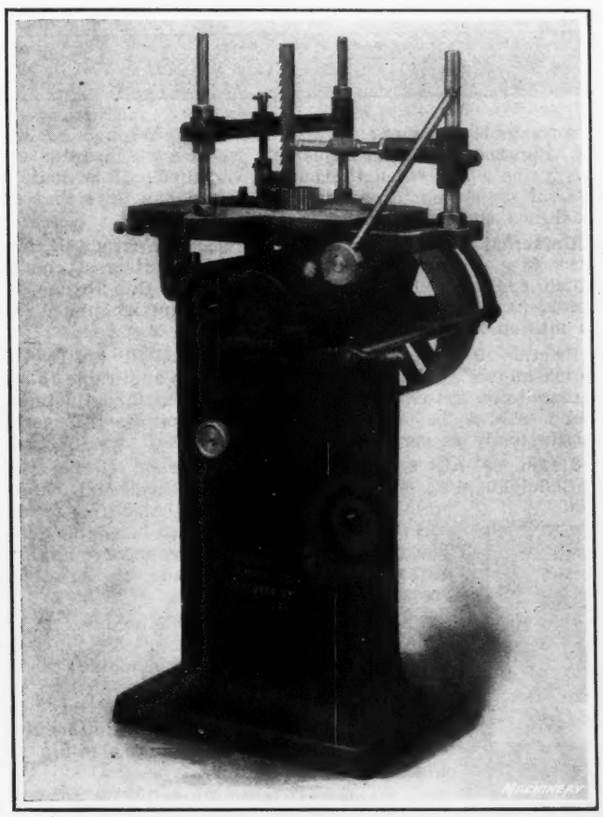
Continuous Milling Machine built by the Betts Machine Co.

Power for driving this miller is furnished by either a pulley or an individual electric motor at the top of the machine. Each of the spindles carries a milling cutter and may be adjusted vertically by hand.

A split tapered bushing provides for taking up wear in the bearing on which the table revolves about the column, in addition to which there is a flat bearing on the bed. The table is driven through a large internal gear, and four rates of continuous feed are obtained through sliding steel gears. All bearings are bronze bushed and all gears run in a bath of oil. None of the gears are ever in mesh except those that are actually transmitting power, so that there is no unnecessary wear. Obviously, the work-holding fixtures must be adapted to the pieces to be milled, and they are carried on a table that revolves continuously. No time is lost in chucking as the work is changed while the fixture is passing from one cutter to the next. It is stated that one of these machines will do as much work as can be handled by two men.

C. F. DAVIS KEYSEATER

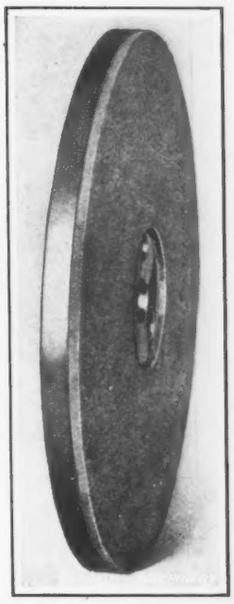
The C. F. Davis Machine Co., Inc., 133 Andrews St., Rochester, N. Y., has recently brought out a No. A keyseater, which is shown in the accompanying illustration. This machine is designed to cut internal keyways in gear blanks, pulleys, crank handles, etc., and it can also be used for slotting and oil-grooving. The work is mounted on a bushing which is securely fastened to the table. The cutter is held in a saw block, having lateral adjustment, and travels in a vertical line. The cutter is backed up by an adjustable saw support, which is hinged to facilitate removing the work.



No. A Keyseater made by the C. F. Davis Machine Co.

The table carrying the work is fed against the cutter, thus assuring the keyway being cut the same depth at top and bottom. The proper depth of cut is insured by an adjustable stop located on the table. Keyways can be cut in tapered holes by tilting the table to the required angle. A slotting segment graduated to ⅛ inch taper per foot is located on the left-hand side of the table. This machine will cut keyways 1/16 to ½ inch in width in hubs 6½ inches long when the regular clamping stud is used. Special cutters can be made for cutting keyways up to 1 inch in width. The tight and loose pulleys are 12 inches in diameter by 3 inches face, and their recommended speed is 180 revolutions per minute. The table is 16¼ inches in diameter, and the machine weighs approximately 400 pounds.

GARDNER ABRASIVE DISK



"G. I. A." Abrasive Disk made by the Gardner Machine Co.

The abrasive disk shown in the accompanying illustration has been developed by the Gardner Machine Co., Beloit, Wis., for use on disk grinding machines. This product, which has been called the "G. I. A." (Gardner improved abrasive) disk is somewhat different from the ordinary type. A comparison of the construction of the "G. I. A." disk and the regular type will serve to show the principal difference. There are three ingredients which enter into the manufacture of an ordinary abrasive disk; the cloth backing, the bond, and the abrasive grains. The glue bond type of disk is made by first coating a sheet of cloth with hot glue into which is sprinkled the abrasive grains. After setting has taken place, the sheet is cut into circular forms of proper diameter. The approximate thickness of such a disk is a trifle over 1/16 inch, and a disk 18 inches in diameter with a 5-inch hole will weigh approximately 1 pound, 12 ounces. In the case of the "G. I. A." disk, however, the abrasive grains for the bond are first mixed together, and then applied to the cloth backing so as to produce a thickness of ¼ inch. While plastic, the surface of the disks is corrugated so as to tilt the grains into the best cutting position. The weight of a disk 18 inches diameter with a 5-inch hole is 5 pounds.

RICKERT-SHAFER CHASER GRINDER

The Rickert-Shafer Co., 612 W. 12th St., Erie, Pa., is adding to its line a machine for grinding chasers used in self-opening die-heads. This grinder has a throat grinding fixture

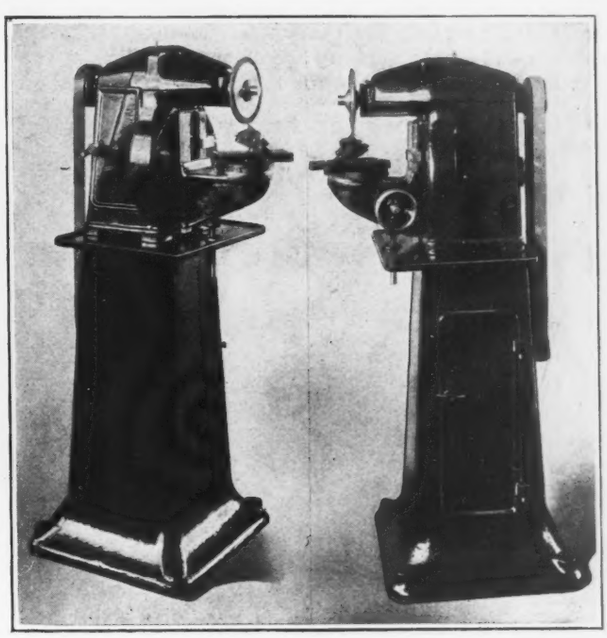


Fig. 1. Column Type Chaser Grinder made by the Rickert-Shafer Co.

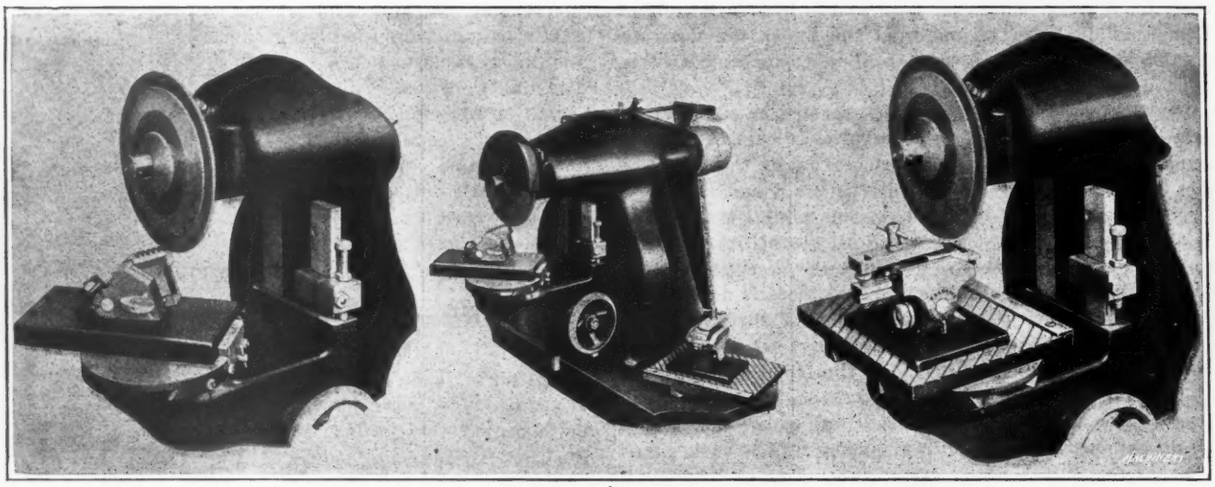
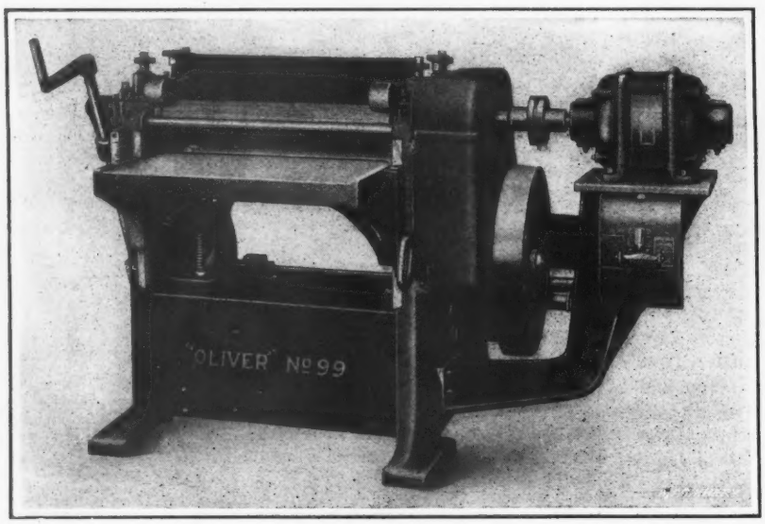


Fig. 2. Throat Grinding Fixture, Bench Type Chaser Grinder, and Face Grinding Fixture

and is equipped throughout with S K F ball bearings. The throat grinding fixture permits chasers for threading ⅛-inch diameter stock and any size up to those for cutting 6-inch stock to be ground by the 6-inch rubber corundum wheel furnished with the machine. To accomplish this, the fixture is arranged as shown at the left in Fig. 2 so that the chaser will be held in the right position to give the desired throat angle. Passing the chaser back and forth under the wheel gives it the radially ground throat which is essential to all hobbed or tapped chasers.

The required throat radius is obtained by adjusting the angle between the fixture slide and the axis of the wheel-spindle. The following will illustrate this more clearly: When the angle between the fixture slide and the axis of the wheel-spindle is zero, the radius ground will be equal to the radius of the wheel, or in this case 3 inches. When the angle is 90 degrees, the radius will be the same as that to which the ⅛-inch thick wheel is dressed or 1/16 inch. In order to grind a radius smaller than 1/16 inch, it is necessary to dress the wheel thinner. A table accompanying the grinder gives the required setting for any radius between 1/16 inch and 3 inches.

This arrangement for varying the radius saves time, as only one size of wheel is required to grind all sizes of chasers. A fixture for grinding the faces of chasers as illustrated at the right in Fig. 2 is also part of the grinder equipment. This fixture is adjustable and graduated so that any desired amount of rake or hook can be given the cutting face, thus adapting the chasers for cutting any material. These grinders are built in either bench or column type and for either motor or lineshaft drive.



Motor-driven Surface Planer made by the Oliver Machinery Co.

OLIVER MOTOR-DRIVEN SURFACE PLANER

The Oliver Machinery Co., Grand Rapids, Mich., has recently brought out the motor-driven surfacer or surface planer shown in the accompanying illustration. This machine is equipped with a self-contained motor drive in which no driving belts or driving pulleys are employed. The motor, which runs at 3600 revolutions per minute, is coupled directly to the cutting cylinder. Three high-speed knives are employed in the cutting head which gives the proper number of cuts per minute.

NEW MACHINERY AND TOOLS NOTES

Adjustable Wrench: Allan-Diffenbaugh Wrench & Tool Co., Baraboo, Wis. An adjustable wrench which automatically grips a nut when the handle is pulled. It is made in several sizes from drop-forged steel and has jaws that are machined and hardened.

Universal Clamps: Burwin Co., Inc., 87 Warren St., New York City. Tools known as the "Force" universal clamps, which are made by the Black Rock Mfg. Co., Bridgeport, Conn., in several styles adapted for holding irregular work on milling machine tables.

Friction Clutch: Link-Belt Co., Chicago, Ill. A friction clutch known as the "Twyncone," which is applicable to any transmission system. This clutch has one point adjustment, and is said to be perfectly balanced so that it will operate satisfactorily at very high speeds.

Steam or Air Engine: H. B. Underwood Corporation, Philadelphia, Pa. A vertical engine built in 3- and 5-horsepower sizes, especially designed for driving portable tools, such as boring-bars and drills. The engine runs at 250 revolutions per minute with 70 to 125 pounds air or steam pressure.

Planing Machine: Powell Machine Co., 245 Stafford St., Worcester, Mass. A 48-inch by 17-foot belt-driven planing machine of the "Hy-Speed-Cut" type. The noteworthy feature of this machine is the accelerating drive which overcomes many of the difficulties heretofore met with in designing planing machines of the heavy-duty type.

Oil Cooler: Griscom-Russell Co., 90 West St., New York City. A device known as the G-R "Multiwhirl" oil cooler, designed for cooling the oil used in the lubrication of turbine bearings and reduction gears, or the quenching oil used in the heat-treatment of steel. It is claimed that the oil can be maintained at the proper viscosity for efficient results.

Automatic Lifting and Tiering Truck: Automatic Transportation Co., 2935 Main St., Buffalo, N. Y. An electric-driven truck designed to pick up and elevate loads with its own power to suitable heights for placing ma-

terial in box cars, on trucks, wagons, etc. It is claimed that the truck will lift a load of 4000 pounds any distance from 1 inch to 6 feet at the rate of 1 foot in 15 seconds.

Starter for Induction Motors: General Electric Co., Schenectady, N. Y. An automatic starter for use with squirrel-cage induction motors driving lineshafts, pumps, compressors, and similar devices. The starter is operated by a push-button or by a float switch, pressure governor, or some similar automatic accessory.

Pneumatic Riveter: Baird Pneumatic Tool Co., Kansas City, Mo. The Baird type of riveter supported on a stand. This riveter is intended for use in riveting traction plates on the rims of pneumatic tires. It has a 10-inch reach and a 9-inch gap, and will deliver a maximum squeeze of 70 tons with 100 pounds air pressure.

Crankshaft Bearing and Flange Turning Lathe: Wickes Bros., Saginaw, Mich. A line of 20-inch lathes especially adapted for turning the line bearings and flanges on automotive crankshafts. They can be furnished for belt drive or with a motor mounted on the head casting. The main spindle has eight feeds ranging from 1/64 to ⅛ inch.

Drilling Machine: Holt Electric Co., 377 S. Pierce St., Milwaukee, Wis. A 20-inch vertical drilling machine having a square base provided with T-slots for clamping work, and a regular slotted table 18 inches in diameter. The spindle has a No. 3 Morse taper; it has vertical travel of 11⅜ inches, and is driven by a 2-inch belt running on four-step cone pulleys.

Welding and Cutting Torches: K-G Welding & Cutting Co., Inc., 556 W. 34th St., New York City. Oxy-acetylene cutting and welding torches known as the K-G Model M. The heads, tips, and nuts that are exposed to the heat are made of monel metal, which is claimed to give the torches long life and permit them to be used continuously at high temperatures.

Drill Chuck: Scully-Jones & Co., 647 Railway Exchange Bldg., Chicago, Ill. A drill chuck or collet made with tapers to suit all standard drilling machine spindles, and with holes to fit all sizes of straight-shank drills. These chucks are of such construction that they permit drills on multiple-spindle drilling machines to be spaced much closer than if held in the ordinary type of drill chuck.

Sand-blasting Machine: Scully-Jones & Co., 647 Railway Exchange Bldg., Chicago, Ill. A self-contained sand-blasting machine combining a work chamber, sand pressure reservoir, and dust collector. An electric light inside the chamber and a window above the mouth of the machine enable the operator to observe the work at any time. The machine is 6 feet 6 inches in height by 1 foot 10 inches in diameter.

Piston-turning Machines: Foote-Burt Co., Cleveland, Ohio. Multiple-spindle piston-turning machines made in either two- or four-spindle types. The vertical spindles are mounted on a common base, and although all spindles are driven from the same power source, there is no timing connection between the different units other than the constant rate of drive, as their operating functions are all self-contained.

Universal Grinder and Die Grinder Attachment: Lafayette Tool & Equipment Co., 21 S. 12th St., Philadelphia, Pa. A motor-driven universal grinder and button die grinding attachment for grinding internal and external precision threads on gages, and which can be used for cylindrical and taper grinding, relieving taps, and similar work. A special attachment is provided for use in reclaiming button dies.

Electric Transformer: General Electric Co., Schenectady, N. Y. A line of General Electric MTQ auto transformers of 1 to 1 ratio in sizes 1, 3, 5, 7, 10, 15, 20, and 25 kva. output. The transformers are air-cooled and suitable for indoor or outdoor use on 220-volt circuits having frequencies between 50 and 140 cycles per second. They are designed for deriving three-phase current from two-phase, four-wire service and vice versa.

Grinding and Buffing Machines: Van Dorn Electric Tool Co., Cleveland, Ohio. A line of one-horsepower electric grinding and buffing machines of heavier types than those previously made by this company. The new line includes a floor grinder and a bench grinder with two guarded wheels; a floor grinder with one guarded wheel and a left-hand extension having a polishing brush; and a floor type machine with a buffer and a grinding extension.

Pyrometer Recording Instrument: Charles Engelhard, 30 Church St., New York City. A recording pyrometer having a 5½-inch scale, which is calibrated both in temperature and corresponding millivolt range. The charts are of the continuous-roll type, approximately 100 feet in length. The instrument is 11 inches high, 8½ inches wide, 8½ inches deep, and is made in two types, Type RL being a single-record type while Type RM is a multiple-record instrument.

Cylinder Grinder: Heald Machine Co., 16 New Bond St., Worcester, Mass. This company has made some changes in the design of its No. 65 cylinder grinder. The distance between the center line of the eccentric and of the table has been increased by 1⅝ inches, so that it is now 9½ inches instead of 7⅞ inches, as previously made. The location of the idler bracket has also been changed from the top of the main drive pulley guard to a position on the guard itself, thus bringing it near the base.

Drilling Machine: Fox Machine Co., 1812 W. Ganson St., Jackson, Mich. A D-12 multiple-spindle drilling machine having the table and column bolted to the base, which contains a reservoir for the coolant. The spindle change-gears and the feed gears are controlled by conveniently located levers. The feed is engaged by a quick-acting clutch, which can be operated either by a hand-lever or automatically by an adjustable stop on the column. The drilling head is provided with from ten to sixteen spindles, and has a travel of 15 inches. The machine weighs 2250 pounds and occupies a floor space of 28 by 36 inches.

* * *

THE BROWN & SHARPE APPRENTICE HOUSE

An unusual departure for taking care of their apprentice boys has been inaugurated by the Brown & Sharpe Mfg. Co., Providence, R. I. An institution known as the "Apprentice House" has been started. The apprentice house is a home for out-of-town boys who are taking courses of training in the Brown & Sharpe apprentice department. It consists of a well-built three-story house located in a good residential section of Providence, only a short distance from the works of the company. This house provides accommodation for twenty-seven boys.

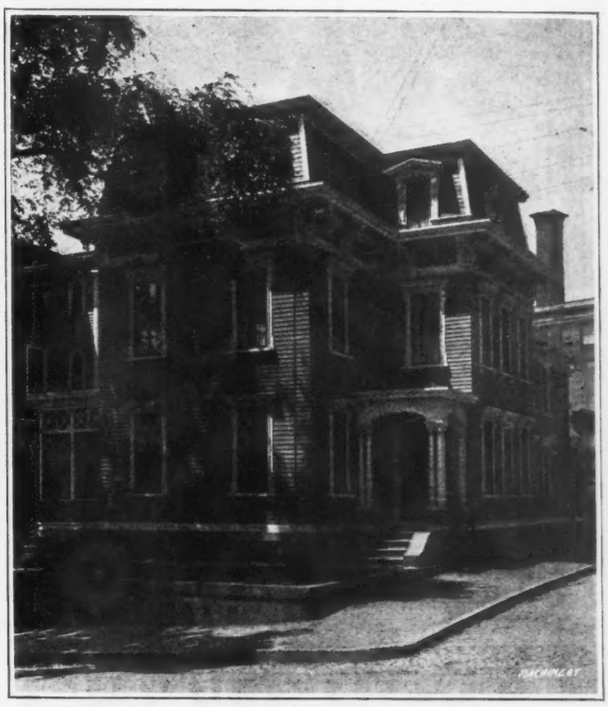


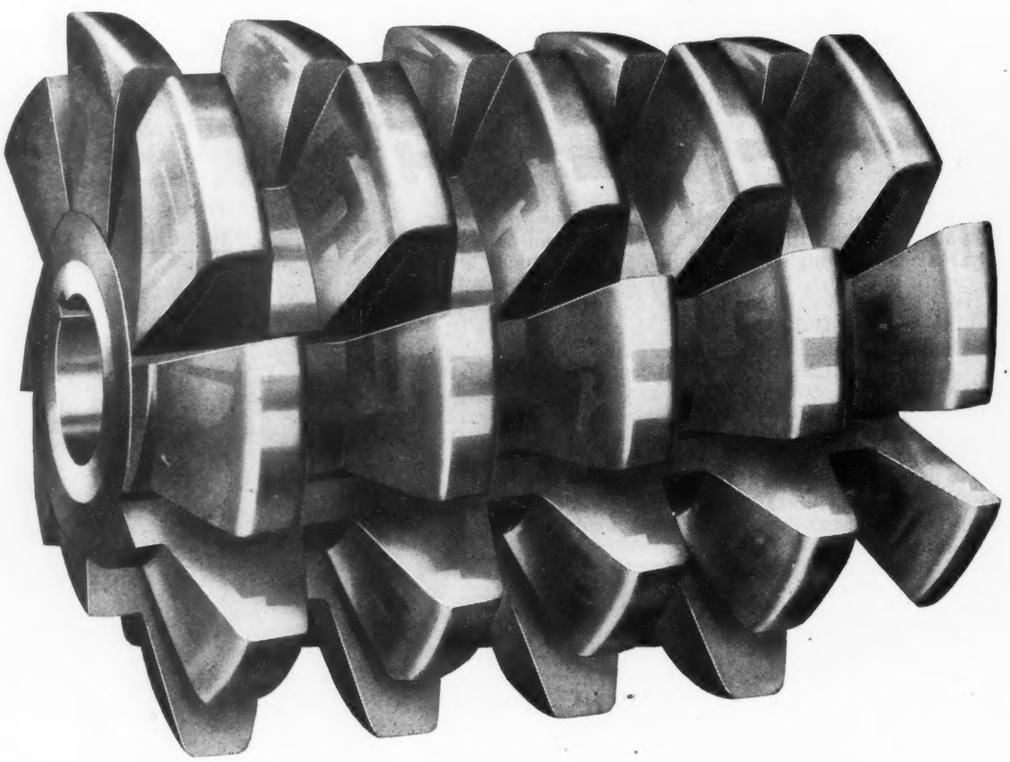
Fig. 1. Brown & Sharpe Apprentice House

The house is under the supervision of the apprentice department, but is directly conducted by a responsible housekeeper and an assistant. There are no set rules, the boys simply being asked when coming into the house to do as they would do in their own homes. The policy is to maintain a thoroughly homelike atmosphere and to avoid any of the institutional tendencies often found in places of this kind. No meals are served, but there are boarding places nearby where the boys obtain their board. The boys pay room-rent for the accommodation provided, but they deal with the housekeeper, and not the company.

When the boys make application for an apprenticeship they include an application for a room at the apprentice

PROMPT

BROWN & SHARPE



FOR INCREASED OUTPUT AND

BROWN & SHARPE MFG. CO.

DELIVERIES

CUTTERS AND HOBS

Quality in cutters cannot be determined by mere examination. It takes actual service to prove their real worth. Brown & Sharpe Cutters and Hobs are made to meet the most exacting requirements for accuracy, quality and length of service. They are made from the best material obtainable, designed to give free cutting action, scientifically heat-treated and subject to rigid inspection before shipment.

CUTTERS	*HOBS*
Regular Stock for	**Worm Wheel**
Milling and	**Spur Gear**
Gear Cutting	**Splined Shaft**
Special to Order	**and Special Purpose**

The methods and processes employed in manufacturing are the outgrowth of over a half century of experience. Modern methods, skilled workmanship and special improved machinery enable us to assure prompt deliveries.

LOWERED OPERATING COSTS

PROVIDENCE R.I.,U.S.A.



Fig. 2. A View in the Living Room of the Brown & Sharpe Apprentice House

house, if this is desired. If there are no openings when the apprentice begins his course, his name is placed on a waiting list and he is helped to find a room for temporary use until a vacancy occurs. The apprentice house is provided with modern improvements in every way, electric light, steam heat, good sized halls, and a large living room furnished with an aim toward comfort and homelike environment and provided with the inevitable victrola. The bedrooms are furnished in an attractive and comfortable manner, and each room contains a study table and chair.

* * *

ORIGINATORS OF BROACHING MACHINES

In connection with the article published in the June number of MACHINERY entitled "Modern Broaching Practice," it is believed that a statement should be made as to the present connections of the men who were instrumental in developing the broaching trade and more especially some of the machines shown in this article.

J. N. Lapointe, mentioned in the article, is no longer actively engaged in the manufacture of broaching equipment of any kind. He is known as the originator of the Lapointe broaching system. The machines shown in the article were designed and patented by Francis J. Lapointe. Joseph N. Lapointe, who originally organized the J. N. Lapointe Co. of New London, Conn., sold out his controlling interest in this firm at the end of 1917, but agreed to remain one year in the employ of the company, after which period he agreed that for ten years he would not engage in or be interested in any plant making or selling broaching machines and equipment. Francis J. Lapointe, his son, is the patentee of the inventions made and sold by the J. N. Lapointe Co. up to 1918, having transferred his patents to it when it was controlled by his father, Joseph N. Lapointe. Francis J. Lapointe is now president of the American Broach & Machine Co., Ann Arbor, Mich., and is not connected with any other firm manufacturing a similar product.

AMERICAN BROACH & MACHINE CO.
Ann Arbor, Mich.

* * *

The exports of mining machinery from the United States, including oil well machinery, during May, 1920, amounted to $1,131,000. Of this, oil well machinery was represented by over $500,000.

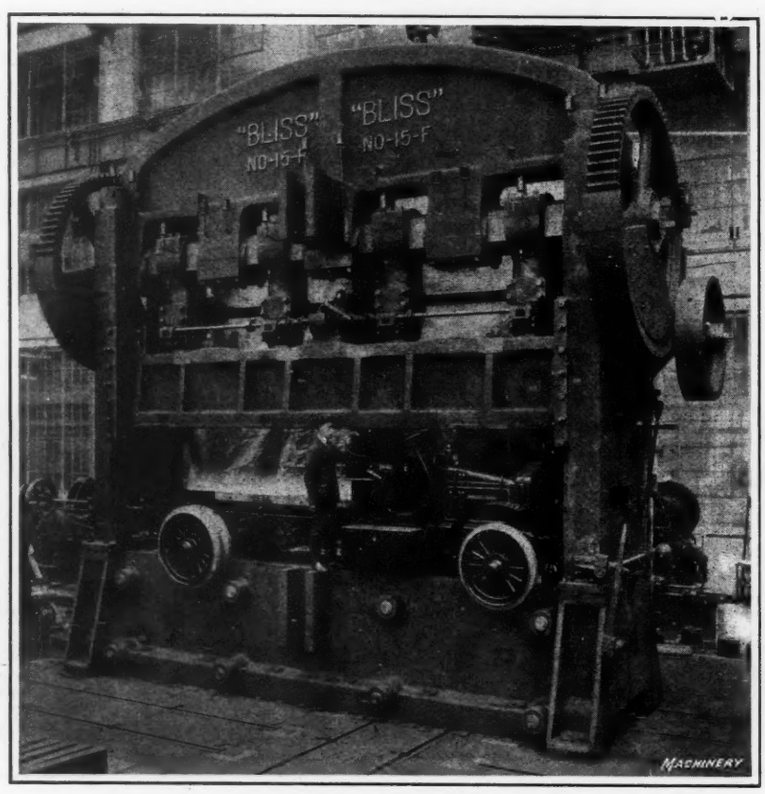
MEETING OF STEEL TREATING SOCIETIES

The American Steel Treaters' Society and the Steel Treating Research Society will hold their annual convention and exhibit at the Commercial Museum, Philadelphia, Pa., September 14 to 18. It is planned to make the exhibition the greatest of its kind ever held. Eighty thousand square feet of floor space at the Commercial Museum will be used for exhibiting heat-treating appliances and heat-treating products. In conjunction with the exhibition there will be a joint convention of the two societies, at which important papers on steel and its heat-treatment will be read. The sessions of the convention will be held in the same building as the exhibition. The secretary of the Steel Treating Research Society is L. S. Carrick, Box 834, Detroit, Mich., and the American Steel Treaters' Society may be addressed at 208 N. Wabash Ave., Chicago, Ill., where applications for space at the exhibition in Philadelphia should also be sent. It is planned to join the two societies mentioned into one society (as previously mentioned in the March number of MACHINERY, page 689) known as the American Society for Steel Treating, the new society coming into action immediately following the convention.

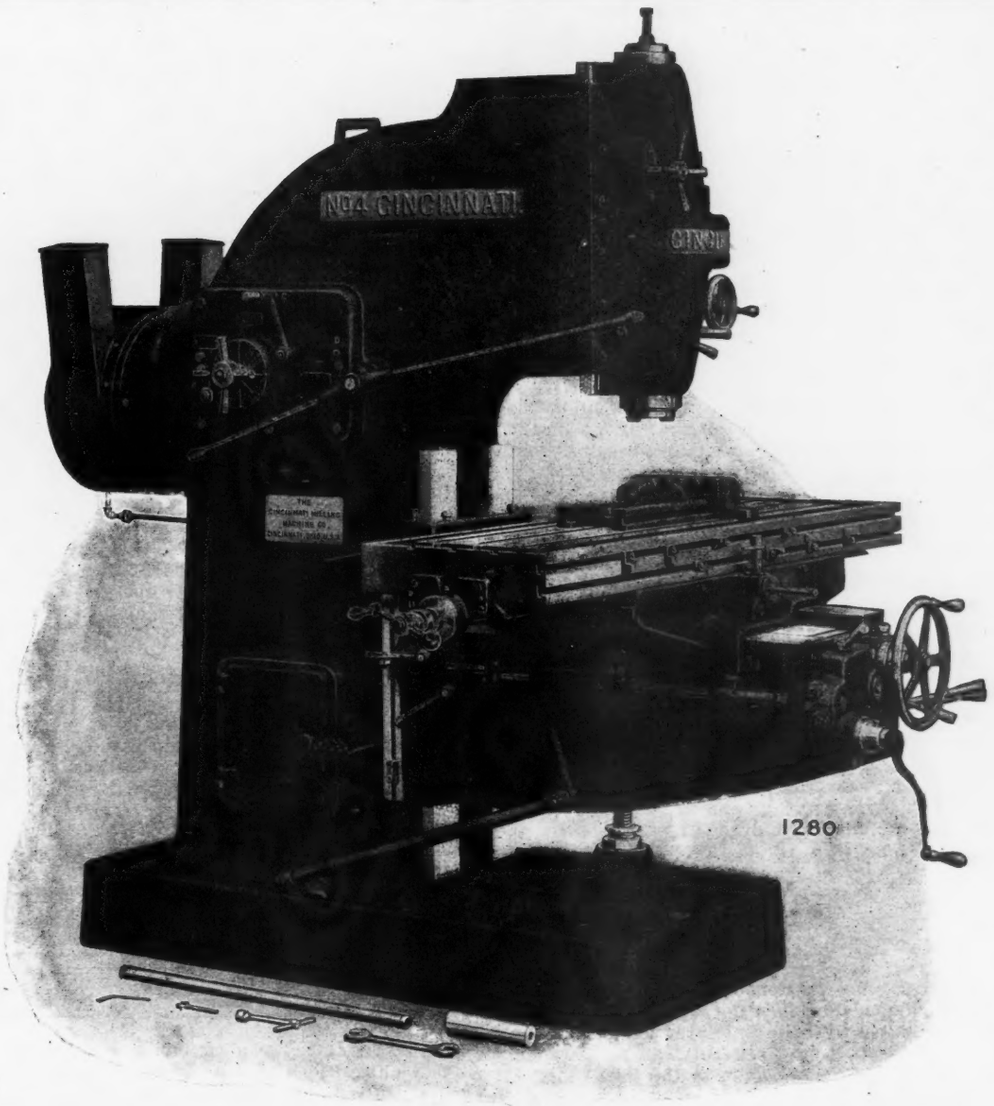
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POWER PRESS OF UNUSUALLY LARGE SIZE

The primary use of the four-crank power press which is here illustrated and described is for the blanking and perforating of side rails for the largest sizes of motor truck frames. Of course it could be used for other purposes, including the performance of heavy forming operations. The Pierce Arrow motor truck chassis shown in the illustration was placed in the press for the purpose of emphasizing its unusual size, which will be further brought out by the following dimensions: Area of bed, 252 by 48 inches; area of slide face, 242 by 40 inches; number of strokes per minute, 5; and total height, 25 feet 9 inches. This machine is known as a No. 15-F four-crank press, and was recently built at the E. W. Bliss Co.'s plant in Brooklyn, N. Y.



No. 15-F Four-crank Power Press of Unusually Large Size built by the E. W. Bliss Co.



The New No. 4 Vertical Cincinnati Miller

(Patent Rights Fully Reserved)

Some of its big productive features are—

Intermittent Feed.
Power Quick Traverse in Both Directions.
Square Gibbing with Narrow Guides.
Feed Changes at Front of Knee.
Safety Couplings in Feed Transmissions.
Individual Feed Control Levers.
Automatic Lubrication.
Centralized Oiling.
Flooded Lubrication for Cutter and Work.
Hardened Sliding Gears Throughout.
Starting Lever at Front.
Automatic Brake.
Spindle Can Run in Either Direction.
Spindle Driven Through Spur Gears.
Face Gear of Large Diameter for Large Cutters at Slow Speeds.
Secondary Spindle Gear Provided for Small Cutters at Fast Speeds.
Spindle Gears Keyed to Sleeve, which is Keyed to Spindle at its lower end.
Back Gears Slide on Hardened Shaft having Four Integral Keys, and Automatically Maintain Proper Driving Relation for All Positions of Vertically Adjustable Spindle Head.

Ask for descriptive matter

THE CINCINNATI MILLING MACHINE CO., Cincinnati, Ohio

PERSONALS

FRANK J. FARRELL has been appointed eastern representative for the Precision & Thread Grinder Mfg. Co., Philadelphia, Pa., manufacturer of the multi-graduated precision grinder.

H. L. SCHMIEDER, for a number of years superintendent of the Advance Tool Co., Cincinnati, Ohio, is now representing the Langhaar Ball Bearing Co., Aurora, Ind., in Milwaukee and vicinity.

WILLIAM W. JOHNSON, formerly tool engineer with the American Axle plant of the Standard Parts Co., is now located with the George T. Trundle, Jr. Engineering Co., Cleveland, Ohio, in the capacity of chief engineer.

HENRY A. POTTING, for eleven years superintendent of the P. A. Geier Co., Cleveland, Ohio, has organized a company known as the Delta Machine & Tool Co., at 1265 W. 2nd St., Cleveland, Ohio, to make special tools, jigs, and machinery.

A. H. GRAYBURN, for the last four years assistant to the vice-president of the Norma Co. of America, Long Island City, N. Y., manufacturer of ball and roller bearings, has been made assistant secretary and assistant treasurer of the company.

C. N. LEO, for the last eight years in charge of the warehouse sales for the W. M. Pattison Supply Co., Cleveland, Ohio, is now associated with the Hess-Schenck Co., 221 St. Clair Ave., Cleveland, Ohio, in the capacity of sales representative.

C. R. SYME, formerly Dayton sales representative of the W. M. Pattison Supply Co., Cleveland, Ohio, will represent the Hess-Schenck Co. at 221 St. Clair Ave., Cleveland, in the southern Ohio and Indiana territory. Mr. Syme will be stationed at Dayton.

FRED A. BIGELOW has been elected president of the Carpenter Steel Co., Reading, Pa., succeeding W. B. Kunhardt, who becomes chairman of the board of directors. Mr. Bigelow has been connected with the company since 1904 in the capacity of salesman, sales manager, and general sales manager.

HARRY A. RASELEY, formely sales manager of C. E. Johansson, Inc., Poughkeepsie, N. Y., has become export sales manager for the Nordyke & Marmon Co., Indianapolis, Ind. Before joining the Johansson organization he represented the General Motors Corporation in the export field for several years.

ROBERT R. LASSITER, who was formerly mechanical superintendent of the Richmond Forgings Corporation, Richmond, Va., has become associated with the Dale-Brewster Machinery Co., Inc., 54 Lafayette St., New York City, as part owner, and will hold the position of assistant to the president, in charge of engineering sales.

THOMAS P. ORCHARD, previously secretary and sales manager of the Service Engineering Co., Inc., New York City, has been appointed director of sales with the Arthur Knapp Engineering Corporation, 19 W. 44th St., New York City. The company is engaged in the design and manufacture of machinery, tools, and equipment for quantity production and interchangeable manufacture.

F. M. RODGERS of London, England, has been appointed European manager of the Westinghouse Electric International Co., East Pittsburg, Pa. J. W. WHITE has been appointed manager for Cuba, and will have offices in the Royal Bank of Canada Bldg., Havana, Cuba. L. T. PECK has been appointed manager for Argentina, with headquarters at Bartolome Mitre 754, Buenos Aires.

E. D. MITCHELL has been appointed manager of the New York branch of Alfred Herbert Ltd., 54 Dey St., New York City, to take the place of W. J. Fuller. Mr. Mitchell first became connected with the company in 1906, and has had considerable experience in connection with the export end of the business, having visited the Far East, India, and Continental Europe. He is also a director in the Société Anonymé Alfred Herbert, Paris, France.

H. F. GRIFFITH has been appointed assistant to the general manager of the Westinghouse Electric International Co. at East Pittsburg, Pa. G. H. BUCHER has been appointed assistant to the general manager in New York City. A. B. COLE, assistant manager of the Department of Publicity of the Westinghouse Electric & Mfg. Co., of East Pittsburg, Pa., has been placed in charge of the advertising and promotion work for the Westinghouse Electric International Co.

NORMAN BELL has been made assistant sales manager of the Norma Co. of America, Long Island City, N. Y., manufacturer of ball and roller bearings. Mr. Bell has been connected with the concern for over three years as sales engineer. His training and experience in the mechanical and automotive fields include association with a leading British manufacturer of motor cars and four years' service in charge of the motor accessories department of the Lunkenheimer Co. of Cincinnati, Ohio.

A. J. STRONG, who was associated for a number of years with the Pratt & Whitney Co., Hartford, Conn., and later with the Motch & Merryweather Machinery Co., at Detroit, Mich., has been appointed sales manager of the Detroit branch of the Reed-Prentice Co., Becker Milling Machine Co., and Whitcomb-Blaisdell Machine Tool Co., whose sales and purchasing departments have recently been consolidated. W. D. CREIDER, formerly president of the Saxer-Creider Machinery Co., Erie, Pa., and for the last two years manager of the Modern Tool Co., in Cleveland, Ohio, has become sales manager of the Chicago branch of these three companies at 28 N. Clinton St.

LAWRENCE G. SPEALMAN, who has been the representative in Michigan of C. E. Johansson, Inc., Poughkeepsie, N. Y., for the last year and a half, has been made sales manager, with headquarters at Poughkeepsie. Mr. Spealman has had many years of experience as toolmaker and production engineer with the National Cash Register Co., Buick Motor Car Co. and Dayton Engineering Laboratories. The Michigan territory will be taken over by J. K. MURRAY, who is at present a member of the sales organization in Poughkeepsie, and he will make his headquarters in Detroit. Mr. Murray is familiar with the Michigan territory, having previously been connected with several automobile industries in that locality.

OBITUARIES

B. F. MECHLING, president of the Albro-Clem Elevator Co., Philadelphia, Pa., died July 2, at his home in Philadelphia, aged seventy-three years. Mr. Mechling had been president of the company for twenty-seven years. He was also president of the Elevator Safety Appliance Co. of Philadelphia and a director of Mechling Bros., Camden, N. J., manufacturers of heavy chemicals.

* * *

CONVENTION OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION

The annual convention and exhibit of the American Foundrymen's Association will be held in Columbus, Ohio, during the week beginning October 4. Present indications point to the largest exhibit so far held by the association. There will be many new exhibitors this year of machine tools and shop equipment, it being recognized that many of the men interested in the foundrymen's association meetings also operate machine shops. Many of the machines exhibited will be shown in operation. The secretary's address is 140 S. Dearborn St., Chicago, Ill.

COMING EVENTS

September 14-18—Second annual convention and exhibit of the American Steel Treaters' Society of Chicago, Ill., and the Steel Treating Research Society of Detroit, Mich., in the Commercial Museum, Philadelphia, Pa. Department of Exhibits, 208 N. Wabash Ave., Chicago, Ill.

September 20-October 9—Sixteenth annual convention of the International Association of Machinists, at Rochester, N. Y.

October 4-9—Convention and exhibit of American Foundrymen's Association at Columbus, Ohio.

December 7-10—Annual meeting of the American Society of Mechanical Engineers at 29 W. 39th St., New York City.

SOCIETIES, SCHOOLS AND COLLEGES

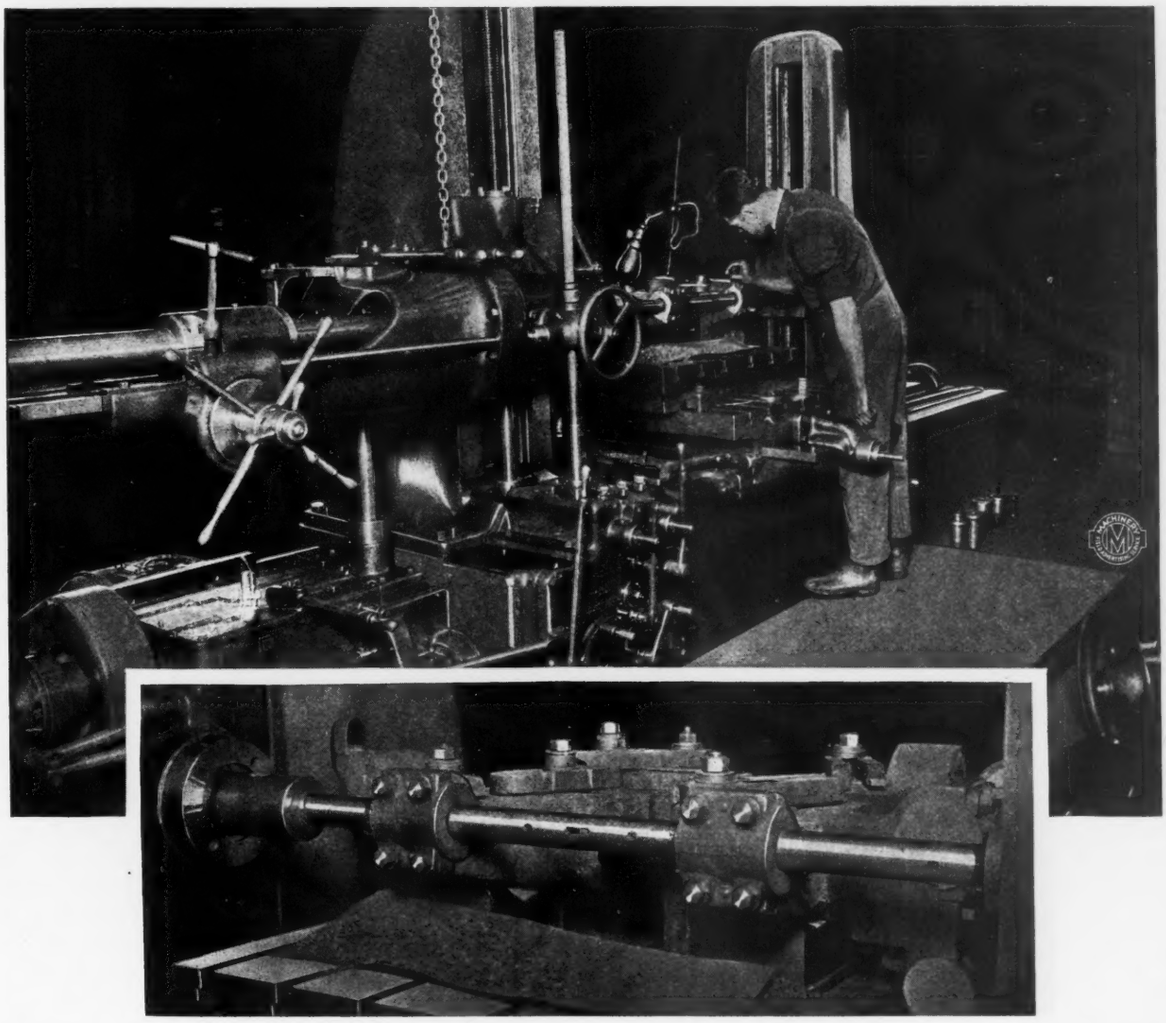
Beloit College, Beloit, Wis. General catalogue for 1919-1920, containing calendar, announcements, outline of courses, and general information.

Polytechnic Institute of Brooklyn, 85 Livingston St., Brooklyn, N. Y. Catalogue of the College of Engineering, containing calendar and courses of study for 1920-1921.

New Hampshire College of Agriculture and the Mechanic Arts, Durham, N. H. Catalogue containing calendar, announcements, and courses of study for 1920-1921.

University of Missouri, School of Mines and Metallurgy, Rolla, Mo. Catalogue for 1919-1920 containing calendar, courses of study, and other information relative to the university. Bulletin containing the war records of members of the school who were in the service of the Army or Navy during the war.

Columbia University—School of Mines, Engineering, and Chemistry, Morningside Heights, New York City. Bulletin of information, containing outline of professional courses in mining, metal-



Three Lucas "Precision" Horizontal Boring, Drilling and Milling Machines

Always Busy on Jigs and other Large Pieces Held to Close Limits

Photographs and data obtained at the Baird Machine Company's plant at Bridgeport, Conn., where these machines have seen several years of service.

THESE machines are used for milling, drilling and boring—the one in the foreground being engaged in boring shaft bearing holes in a slide for a wire forming machine. There are ten of these holes, not cored but bored from solid stock, and they must all be on the same center line—limits for alignment and diameters of the holes being plus and minus 0.001".

Faces of bearings and caps are first milled off and caps drilled and tapped in place; after which the bearing holes are drilled, bored and reamed. Diameters are $2\frac{3}{16}$" and the bearing on each one is $4\frac{1}{4}$" long.

Think this over and write for a description of the machine

LUCAS MACHINE TOOL CO. NOW AND ALWAYS OF **CLEVELAND, OHIO, U.S.A.**

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry. Societe Anonyme Belge, Alfred Herbert, Brussels. Allied Machinery Co., Turin, Barcelona, Zurich. Benson Bros., Sydney, Melbourne. V. Lowener, Copenhagen, Christiania, Stockholm. R. S. Stokvis & Zonen, Rotterdam. Andrews & George Co., Tokyo.

lurgy, civil engineering, sanitary engineering, electrical engineering, mechanical engineering, and chemical engineering for 1920-1921.

BOOKS AND PAMPHLETS

Reflecting Power of Monel Metal, Stellite, and Zinc. By W. W. Coblentz. 6 pages, 7 by 10 inches. Published by the Department of Commerce, Washington, D. C., as Scientific Paper No. 379 of the Bureau of Standards. Price, 5 cents.

Principles of Cylindrical Grinding. By Charles H. Norton. 47 pages, 5 by 7 inches. Published by the Norton Co., Worcester, Mass.

This book is a treatise on the principle of cylindrical grinding, based on the many years of experience of the company. The subjects treated are as follows: Relation between Speed of Work, Speed of Traverse, and Width of Wheel; Relation between Grade of Wheels and Speed of Work; Relation between Depth of Cut, Speed of Work, and Grade of Wheel; Wheel Speeds; Grade and Grain of Wheels; Depth of Cut; Width of Wheel Face; Finishing; Balance of Wheels; Traversing Worktable versus Traversing Wheel; Truing and Dressing of Wheels; Lubrication; and Wheel Service. The book has an appendix on the Grain Depth of Cut, which is a reprint of an article by George I. Alden, presented before the American Society of Mechanical Engineers, containing a mathematical analysis of the grain depth of cut, including a general equation for determining the proper depth.

Motor Boats and Boat Motors. By Victor W. Page and A. Clark Leitch. 524 pages, 6 by 9 inches; 372 illustrations. Published by Norman W. Henley Publishing Co., 2 W. 45th St., New York City. Price, $4.

This work is compiled to serve as a handbook for those interested in motor boats. It considers all the details of modern hulls and marine motors, and deals exhaustively with boat design and construction, design and installation of all types of marine engines, and boat and engine maintenance and repair. It is written in a non-technical style in order to be easily understood by motor-boat owners who are desirous of learning about the mechanical construction and operation of their engines, so that they can adjust and repair them intelligently. The first part of the work is devoted to the hull and fittings, and the second part to the power plant and its auxiliaries. The material of especial interest to readers of MACHINERY is that relating to the engine, which includes the chapters on Types and Operating Principles of Boat Motors; Typical Boat Motors; Power Plant Auxiliaries; Power Plant Installation; and Care and Repair of Motors.

Exporter's Gazetteer of Foreign Markets. Compiled and edited by Lloyd R. Morris. 808 pages, 6 by 9 inches. Published by the "American Exporter," 17 Battery Place, New York City. Price, $10.

This is the 1920 edition of a book which contains a condensed survey of the world's markets and industries, for the use of manufacturers, exporters, bankers, shipping and allied trades. In view of the present activity to develop trade with foreign countries, the information here presented should prove of interest to all concerned either actually or prospectively with foreign trade. The countries of the world have been grouped in alphabetical order by continents and other major geographical divisions so that adjoining markets are found together. Under each country will be found detailed information on area and population; commerce; production and industry; railroads; telegraphs and telephones; money; weights; measures; commercial language; local advertising mediums; principal shipping routes; customs tariffs; consular regulations and consular representatives; cable rates; mail time; postal rates, and regulations respecting parcel post, money orders and reply coupons. The section under each country dealing with commerce contains tables showing the value of the total foreign trade for a series of years; the value of imports and exports by commodities and countries; and the value of its imports from and exports to the United States for ten years or more. Under production and industry, a detailed survey is given of the various industries including agriculture, forest and mineral resources and manufactures, and in the majority of cases a table has been included showing the number of each kind of manufacturing enterprise together with the number of persons employed, the capitalization, the value of annual output, and the consumption of raw material. Tables are also given showing the world's production and consumption of principal necessities and materials, as well as the world's equipment of shipping, railroads, telegraphs, and automobiles. Comparative tables show the relative growth of the export and import trade in the United States, Great Britain, France, and Germany. Separate sections of the book are devoted to the new states, Czecho-Slovakia, Jugo-Slavia, Poland, Finland, Latvia, Lithuania, Esthonia, Ukrainia, Austria, and Hungary. The book contains a number of charts, a map of the world, a map of the new Europe, and line maps of each of the markets.

NEW CATALOGUES AND CIRCULARS

Green Engineering Co., East Chicago, Ind. Circular advertising the Green steam jet ash conveyor.

Gisholt Machine Co., 9 S. Baldwin St., Madison, Wis. Circular containing illustrations of the plant and views in Madison.

United States Blueprint Paper Co., 327 S. La Salle St., Chicago, Ill. Circular illustrating a set of drawing instruments.

Smith & Serrell, Central Ave. at Halsey St., Newark, N. J. Circular descriptive of "Pintite" rigid couplings for lineshafts.

General Fireproofing Co., Youngstown, Ohio. Circular advertising steel shelving for factories, offices and other industrial uses.

Queen-Gray Co., Philadelphia, Pa. Bulletin A-5 of precision levels for use in machine shops in erecting machine tools and other similar work.

Griscom-Russell Co., 90 West St., New York City. Bulletin 1130, descriptive of the Bundy oil separator, for removing oil from exhaust steam in power plants.

Hobart Bros. Co., Troy, Ohio. Bulletins 17 and 64, describing the H. B. battery charger, which is capable of charging from one to ten 6-volt batteries at one time.

Electric Controller & Mfg. Co., Cleveland, Ohio. Bulletin 1044, treating of Type ZB starting switches for small alternating-current motors of 7½-horsepower capacities.

Chapin & Baker Mfg. Co., Inc., Syracuse, N. Y. Catalogue illustrating the jigs and fixtures, counterboring and spot-facing tools, end-mills, gear blocking tools, and turning tools made by this company.

Electric Furnace Co., Alliance, Ohio. Circular entitled "The Crisis in Fuel Oil," suggesting the use of electricity as a solution of the problem, and giving data relating to the Baily type of resistance electric furnace.

H. H. Arnold Co., Rockland, Mass. Circular of "Economy" machine reamers, hand reamers, counterbores, and milling cutters, all of which are provided with high-speed steel blades held in low-carbon steel bodies.

Hyatt Roller Bearing Co., 6th Ave. and 41st St., New York City. Circular showing the application of Hyatt roller bearings in mine locomotives and cars, motor trucks and motor cars, textile machinery, and power farming machinery.

Stow Mfg. Co., Inc., Binghamton, N. Y. Bulletin 20, giving price lists, dimensions, horsepower transmitted, and other data relating to "Stow Binghamton" flexible shafting for motor, belt, or rope drive, which is made in portable, bench, pedestal, and suspended types.

Smalley-General Co., Inc., Bay City, Mich. Bulletin K, containing line illustrations showing details of construction of Smalley-General thread milling machines. Circular containing recommendations for motors and electrical equipment to be used in connection with Smalley-General thread milling machines.

Pennsylvania Pump & Compressor Co., Easton, Pa. Form 100, covering Pennsylvania Class 3A power-driven, single-stage, straight-line air compressors. The bulletin describes, among other features of design, a new type of ring plate valve and an oil float gage for determining the level of oil in the crank basin.

Alfred Herbert, Ltd., Coventry, England (New York City office 54 Dey St.). Section K2, illustrating and describing a microscopic measuring machine for measuring screw-thread tools, formed tools, gages, threaded work, and similar pieces. The construction is described in detail, and the dimensions, weight, etc., are given.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa. Miniature catalogue 5-A-1, containing a complete list of Westinghouse insulating materials and supplies, including mica, micarta, and bakelite micarta plates and tubing, treated and untreated cloths and papers, insulating and soldering compounds, insulating oils, and tapes.

Dunbar-Wood Engineering Co., Inc., E. 32nd St., Covington, Ky. Catalogue descriptive of the Dunbar variable-speed pulley, which can be used with any source of power—either lineshaft, engine, or motor—for driving any kind of machinery at varying speeds, without employing cones, shifting gears, or variable-speed motors or engines.

Van Keuren Co., 362 Cambridge St., Boston 34, Mass. Circular M 21 descriptive of the Van Keuren optical measuring equipment and its application in the shop to precision measurements of gages and tools by light-wave interference. Rules are given for the guidance of the mechanic, particularly with reference to the measurement of flat combination gage-blocks.

Canton Foundry & Machine Co., Canton, Ohio. Catalogue illustrating and giving specifications for the Canton line of portable floor cranes and hoists, for carrying work to parts of the shop that cannot be reached by overhead cranes. This apparatus combines the services of a crane, hoist, and truck, and is therefore useful in small shops not equipped with overhead systems.

Wetmore Reamer Co., Milwaukee, Wis., is distributing a new publication entitled "Reamings," which is published monthly in the interests of the Wetmore reamer salesmen and distributing houses. It contains news about the factory and salesmen, as well as talks on the various types of reamers produced by the company, matters of sales policies, comments on troubles and their remedy, and similar subjects.

Davis-Bournonville Co., Jersey City, N. J. Bulletin 550, illustrating and describing the Davis-Bournonville No. 1-A radiagraph, a mechanically operated cutting torch for use in shipyards, bridge works, boiler shops, locomotive shops, and other plants that need portable equipment for cutting and beveling plate and structural steel near the place of erection. The bulletin shows some examples of characteristic cutting done with the radiagraph.

W. S. Rockwell Co., 50 Church St., New York City. Bulletin 217, containing a review of methods developed in recent years for the heat-treatment of metals, and a description of automatic and semi-automatic furnaces for continuously heating, hardening and tempering crankshafts, light bar stock, coil springs, light rod stock, tubes, billets, drop-forgings, dies, etc. A large number of installations of various types of furnaces used for this class of work are illustrated.

Whitman & Barnes Mfg. Co., Akron, Ohio. Catalogue 92, giving dimensions and price lists for W. & B. twist drills and reamers. Attention is called to the fact that this catalogue does not include screw and drop-forged wrenches presented in previous catalogues, as the company no longer makes these lines, its manufacturing facilities being devoted exclusively to twist drills and reamers. The catalogue also contains tables of tap drill sizes, decimal equivalents, cutting speeds and feeds, and other miscellaneous data.

Baldwin Chain & Mfg. Co., Worcester, Mass. General catalogue, edition F, covering the complete line of power transmission chains and sprockets, including roller chains, block chains and special chains, made by the company. The catalogue shows application of these chains for various classes of drives and gives data for selecting a roller chain drive, determining the length of a chain, tables of pitch line diameters, and information on lubrication and care of chains, as well as several pages of tables of sprocket dimensions.

South Bend Lathe Works, South Bend., Ind. Lathe Book 19, entitled "How to Run a Lathe." This is one of a number of instruction books brought out by the company, giving information on how to erect, care for, and operate a screw-cutting engine lathe. The book shows a lay-out of a small machine shop, and describes in considerable detail various parts of the lathe and the simpler operations performed on this machine. The book also shows various attachments, and contains, in addition, a considerable amount of information of educational value.

Vacuum Oil Co., 61 Broadway, New York City, is publishing a pamphlet, prepared by its technical department, containing a treatise on bearings and their lubrication. The subjects treated of are as follows: Construction; Bearing Types; Bearing Material; Workmanship; Operating Conditions; Oiling Systems—for Individual Bearings, for Group Bearings, and Special Methods of Lubrication; Oil Distribution; Lubrication; Fractional Heat; Bearing Oils—Physical Tests, Selection of an Oil, and Oil Qualities; Lubricating Greases; Bearing Troubles; and True Economy.

Liberty Tool Corporation, 1318-20 Munsey Bldg., Baltimore, Md. Catalogue covering the line of Liberty tools and equipment, which includes portable drilling machines made in three styles, namely, the double-cylinder, single-cylinder, and single-cylinder (close corner) types; rivet heaters; heating torches; holding-on bars or dolly bars; staybolt heading attachment; bottom riveting rigs; backing-out punches; and high-speed hot chisels. The catalogue contains a brief description of the different tools, as well as illustrations, and a list of the repair parts with the numbers by which they are designated.

Chicago Belting Co., 127 N. Green St., Chicago, Ill. Catalogue and belting reference book containing illustrations showing step by step the operations performed in the manufacture of belting, with brief descriptions of the processes. The various brands of belting and their specific applications are listed, and prices are given for belting of different widths. Information is included concerning methods of lacing, belting, rules for calculating the horsepower, width, length, and speed of belting, suggestions for belt users, and other useful information. One section of the catalogue is devoted to leather packings and specialties, and contains price lists, dimensions, etc.

Buffalo Forge Co., Buffalo, N. Y. Catalogue 700, treating of the Buffalo fan system of heating, ventilating, and humidifying. The book is a treatise on heating and ventilating, rather than an ordinary catalogue of products, much of the material having been taken from this company's handbook on heating and ventilating, entitled "Fan Engineering." It contains many charts and tables, such as a humidity chart, synthetic air chart, tables of pressure and velocity of air, friction of air, indoor temperatures, capacities of Buffalo fans and blowers, and other general data of use to the heating and ventilating engineer.

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The book is divided into five sections, treating respectively, of the application of heating and ventilating systems in public buildings; application in industrial plants; Buffalo apparatus; and formulas and engineering data of use in designing heating and ventilating systems.

Cutler-Hammer Mfg. Co., Milwaukee, Wis. Publication 845, treating of machine tool control and describing Cutler-Hammer controllers. The first half of the pamphlet is devoted to machine tools of all kinds, and gives suggestions for the selection of motor and control apparatus for the different machines. The second half of the book illustrates and describes Cutler-Hammer controllers, both manual and automatic, and gives horsepower ratings for the different sizes. Circular 855, treating of Cutler-Hammer lifting magnets of the circular type and illustrating their application in foundries, steel mills, shipyards, and other plants throughout the country for speeding up production and reducing handling costs.

Edison Lamp Works of General Electric Co., Harrison, N. J., has issued a series of publications under the title "Lighting Data," which include Bulletins 101 to 114, treating respectively, of the following subjects: Maintenance of the Lighting System; Effect of Color of Walls and Ceilings on Resultant Illumination; the Lighting of Show Windows and Show Cases; Artificial Daylight for Merchandising and Industry; 110-vs. 220-volt Circuits from the Standpoint of Lighting Service; Illumination and Production; the Lighting of Office Buildings and Drafting-rooms; Lighting of Schools; Lighting of Textile Mills; Lighting of Piers and Warehouses; Light and Safety; Edison Miniature and Mazda Lamps—Standard vs. Special; Edison Mazda Lamps—Theory and Characteristics.

Hendey Machine Co., Torrington, Conn. Catalogue illustrating and describing in detail the construction of the Hendey line of engine lathes, and attachments for use with these lathes. Specifications are given for the various sizes of lathes, which are made in the cone-head and geared-head types. To meet the demand of the foreign trade, all sizes of these lathes are made with metric pitch lead-screw and special gearing to cut standard pitches of French and international standards, and dimensions and specifications are also given for the metric engine lathes. The spiral relieving attachment is illustrated and described, and a number of relieving operations on different classes of work are illustrated. Data are given on figuring gears for threads not given in the index, formula for thread cutting, etc. Illustrations are included showing the application of motor drive to Hendey lathes.

Golden Co., 405 Lexington Ave., New York City. Prospectus 257, covering the apparatus handled by this company for the Societe Genevoise d'Instruments de Physique of Geneva, Switzerland. These machines and appliances, which can be furnished either to English or metric measurements, include the following: Universal measuring machines for checking and controlling gages and standards of all kinds; high-precision micrometer with a range of from 0 to 4 inches, measuring to an accuracy of 0.000005 inch; comparators for gaging interchangeable parts, measuring to an accuracy of 0.00005 inch; thread gages; standard and reference gages; limit gages; adjustable limit snap gages; machines for adjusting the anvils of adjustable limit gages; laying-out-locating-drilling machine in four models; dividing engines for linear, circular, and cylindrical work; and high-precision standard certified scales and rules.

Crescent Belt Fastener Co., 381 Fourth Ave., New York City. Catalogue 203 containing service data on Crescent belt fasteners for transmission, elevating, and conveying belting. The book is conveniently arranged with a thumb-index, which makes it easy for the belt user to determine rapidly the size that will insure best results. Data are given for belt fasteners intended for high-speed light work on 2-inch or larger pulleys; for light work on 3-inch or larger pulleys with belting from ¾ to 4 inches wide; for general work on 6-inch or larger pulleys with belting 1½ to 8 inches wide; for general work on 9-inch or larger pulleys with belting from 2 to 12 inches; for heavy work on 12-inch or larger pulleys with belting from 5 to 36 inches wide; and extremely heavy work on large pulleys with belting up to 72 inches wide. The catalogue also describes how a Crescent joint is made and gives prices and weights of Crescent plates and rivets.

Peter A. Frasse & Co., Inc., 417 Canal St., New York City, has recently published a new 800-page general catalogue of tools, machine tools, and general machine shop supplies. This is the first large general catalogue that has been issued by the company. It contains complete specifications, including dimensions, prices, etc., for Frasse electric and open-hearth steels; Shelby seamless steel tubes; Renold transmission chains; drill sockets; sleeves; lathe centers; twist drills; arbors; reamers; countersinks; milling cutters; gear-cutters; taps; dies; screw plates; die-stocks; pipe threading machines; vises; wrenches; pliers and nippers; files; screws; bolts; nuts; rivets; nails; micrometers; machinists' and draftsmen's tools; gages; chucks; tool-holders; saws; hammers; blowers; chisels; grinding wheels; oilstones; pulleys; tool stands; pumps; oil and grease cups; welding equipment; blowpipes; clamps; lathe dogs; punches; trucks, etc.; machine tools; air compressors; and woodworking machines. Stock list for July, 1920, covering Shelby cold-drawn seamless steel tubing in round, square and odd sizes.

Heald Machine Co., 16 New Bond St., Worcester, Mass. Instruction book and parts catalogue, explaining the operation and adjustment of the Heald No. 60 cylinder grinding machine. The purpose of the book is to aid users in acquiring a knowledge of these machines, and attention is called to points affecting the rate and quality of production, together with some of the fundamental difficulties that are likely to be encountered in operating. This is a new edition of the book, and a great many new features have been added. Diagrams of the floor plans of the machines, fan lay-outs, etc., are included, and instructions are given for adjusting the machines and for setting up. A section has been added on the selection of grinding wheels. Wet and dry grinding is treated of, as well as speeds and feeds, and the various size arms regularly furnished with these machines. The entire line of grinding machines is illustrated, and in the parts catalogue all the repair parts are shown, the method of presentation being to show a drawing of the entire machine with the various parts numbered, which is followed by line drawings of the separate parts.

TRADE NOTES

Duplex Mill & Mfg. Co., Springfield, Ohio, is building a brick addition to its plant, 50 by 100 feet.

Detroit Tool Co., Detroit, Mich., announces that it has changed its firm name to Detroit Machine Tool Co.

Cooper Hewitt Electric Co., Hoboken, N. J., has removed its St. Louis office to larger quarters in the Title Guaranty Building. A. H. Smith is the district sales manager.

Springfield Finished Castings Co., Springfield, Ohio, has recently been organized to specialize in finished casting work. The company is located in a two-story brick building, 75 by 150 feet.

Detroit Stamping Co., Detroit, Mich., announces that, owing to a renumbering of the Detroit streets, its address after August 1 will be 3445-3459 W. Fort St., instead of 951-957 W. Fort St.

Lay-Vall Brass Co., Orrville, Ohio, has constructed a new foundry building having a casting floor 30 by 50 feet, which will be devoted to jobbing work in brass, bronze, and aluminum castings.

American Production Machine Works, manufacturers of the American production grinder head and piston grinder, have moved to the Hayward Bldg., 965 Woodward Ave., Detroit, Mich. F. M. Ehehalt is the general manager.

Standard Shop Equipment Co., Inc., 1220 Sedgley Ave., Philadelphia, Pa., is moving to larger quarters at Hunting Park Ave. and Nicetown Lane. This change was found necessary owing to the increase of the company's business.

American Broach & Machine Co., Ann Arbor, Mich., is starting operation on the erection of a new machine plant, 200 feet long by 50 feet wide, of mill construction, which will be entirely devoted to the manufacture of broaching machines.

Thomas Spacing Machine Co., Pittsburg, Pa., has purchased the patents and business of the Hill Drill Co., and will manufacture the Hill multiple drilling machine at its plant in Pittsburg. Mr. Hill will supervise the manufacture of the drilling machine under the new arrangement.

Norton Co., Worcester, Mass., announces the opening of a Philadelphia office at 324 Bulletin Bldg., under the direction of Paul Hoffman, district manager. The establishment of this branch office will in no way affect the distribution of Norton grinding wheels, which will be handled as in the past by Powell, Clouds & Co., 602 Arch St., Philadelphia.

Federal Electric Co., 87th and State Sts., Chicago, Ill., announces that plans are in contemplation under which employes of the company will have a voice in the management. John F. Gilchrist, president, stated that the employes could purchase stock in the company on terms convenient to themselves, and that approximately 40 per cent of the employes were already stockholders.

Atlantic Elevator Co., has opened a New York office at 165 Broadway, under the charge of the sales manager, Harlan A. Pratt, formerly manager of the New York Industrial Sales Division of the Westinghouse Electric & Mfg. Co. The Atlantic Elevator Co. states that it has the exclusive right to install the Westinghouse gearless traction elevator equipment in the eastern part of the United States.

Air Reduction Sales Co., 120 Broadway, New York City, has recently completed the construction of a new acetylene plant at 560 Broadway, Gloucester, N. J. The buildings comprising the new unit in the "Airco" service system consist of a gas house, carbide storage building, and a generator house. All the buildings are built of fabricated steel, supported on concrete foundations, and have concrete floors.

Diefendorf Gear Corporation, 118 Dickerson St., Syracuse, N. Y., has been granted a license by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., to manufacture gears from "Bakelite Micarta." The business of the company has grown so rapidly that larger quarters have been obtained at 324 Pearl St., where additional machinery is now being installed. The new quarters will provide double the present floor space.

Bourne-Fuller Co. and the **Upson Nut Co.**, Cleveland, Ohio, have been consolidated under the firm name of the Bourne-Fuller Co. for the purpose of more efficiently handling the business of the two companies, the ownership and management of which have been identical for the last eight years. The Upson Nut Co.'s plants will continue operations as heretofore under the name of the Upson Works of the Bourne-Fuller Co., the products of the nut and bolt departments being marketed under the same trademarks as in the past.

Adirondack Steel Corporation, Watervliet, N.Y., a subsidiary of the Dominion Foundries & Steel, Ltd., Hamilton, Ontario, Canada, has started operations, making steel castings. The company will employ from 900 to 1000 men when working at maximum capacity. The plant covers approximately 102,400 square feet of floor space, and as the corporation has thirty-two acres of land, plenty of room has been allowed for expansion. The foundry capacity is 120 tons of steel a day.

Nightingale & Baker is a partnership recently formed by G. V. Nightingale, formerly western sales manager for the Wilson-Maeulen Co., Chicago, Ill., manufacturer of electric pyrometers, and F. C. Baker, formerly district manager of the same company in Chicago, to act as manufacturers' agents. Nightingale & Baker will represent the Wilson-Maeulen Co. as general agents in all the territory west and southwest of Ohio and Michigan. The new firm is located at 163 W. Washington St., Chicago, Ill.

Velco Mfg. Co., Inc., Greenfield, Mass., has been formed to take over the entire assets of the V. E. LaPointe Mfg. Co., and the business of the latter company has been removed to Greenfield, Mass., where it is housed in a new plant providing more than three times the former capacity. Frank O. Wells, of Greenfield, Mass., former president of the Greenfield Tap & Die Corporation, is president of the new company; J. T. Seller is treasurer; and W. F. Elliott is works manager. The company will manufacture broaches and broaching machines.

Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., announces the following promotions in its service department: G. W. Canney, formerly service manager at East Pittsburg has been transferred to the office of W. K. Dunlap, assistant to the vice-president; L. C. Richards, formerly district service manager at New York, has been transferred to East Pittsburg as electrical manager; A. D. Hunt, of the South Philadelphia works, has been made steam service manager; W. H. Keller has been made office service manager at East Pittsburg.

Roller-Smith Co., 233 Broadway, New York City, manufacturer of electrical instruments, announces the following changes in its sales organization: G. L. Crosby, previously sales manager, is now general sales manager at New York City; M. Frankel, previously assistant sales manager, is now western sales manager at Chicago; W. J. Shire, previously sales engineer, is now eastern sales manager at New York City; C. G. Kahant, previously sales engineer, is now export manager and district sales manager at New York City; F. R. Ryan, J. E. Wood and H. D. Baker remain district sales managers, respectively, of the Chicago, Cleveland, and Detroit territories; C. M. Hunt has been made sales engineer in the New York office, and M. B. Mathley, sales engineer in the Chicago office.

Reed-Prentice Co., Worcester, Mass., **Becker Milling Machine Co.**, Hyde Park, Boston, Mass., and **Whitcomb-Blaisdell Machine Tool Co.**, Worcester, Mass., have combined their sales, purchasing, accounting, and executive departments. The main offices are located at 53 Franklin St., Boston, Mass. J. P. Ilsley is general sales manager, with headquarters at Boston. The various agents throughout the United States that formerly handled the products of these factories are now displaced by direct factory branches in the machine tool centers of the country. These three companies now have combined sales branches in Boston, Worcester, New York, Detroit, Chicago, Cleveland, and Indianapolis. The Reed-Prentice Co. is located at Cambridge St., Worcester, Mass.; A. E. Newton remains vice-president and general manager. The Whitcomb-Blaisdell Machine Tool Co. is located at 134 Gold St., Worcester, Mass.; Charles Hildreth remains president and general manager. The Becker Milling Machine Co. is located at Hyde Park, Boston, Mass.; Scott Taylor is works manager. The other offices are as follows: Grand Central Palace, New York City, P. K. Dayton, sales manager; 26-28 N. Clinton St., Chicago, Ill., W. D. Creider, sales manager; 408 Kerr Bldg., Corner Fort and Beaubien Sts., Detroit, Mich., A. J. Strong, sales manager; 408 Frankfort Ave., Cleveland, Ohio, C. A. Severin, sales manager; 940 Lemcke Annex, Indianapolis, Ind., T. C. McDonald, sales manager.

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The Editor's Talk With MACHINERY'S Readers

SOME years ago one of the well known pioneers in the ball bearing business made an estimate of the number of steel balls used in bearings. His figures added up close to a billion steel balls a year. Since that time the industries employing ball bearings have developed to an extent undreamed of ten years ago. The automobiles and motor trucks of today alone use more steel balls for their bearings than the total number used in all the industries of a decade ago.

THE ball bearing is one of the fundamental parts in modern mechanisms, which owe much of their immensely improved efficiency to these bearings. With great capacity, practically no friction, and almost unlimited wearing qualities a properly mounted and properly cared-for ball bearing represents a really great advance in mechanical practice.

GREAT industries have been developed to produce ball bearings alone, and the methods and machinery employed have been developed along specialized lines to which some of the best mechanical genius of the country has been applied. Some of these methods are described in the article on Manufacturing Three-area Contact Ball Bearings in this number of MACHINERY. In addition to the interest readers will have in the processes and machines described, the bearing itself, capable of taking a large percentage of thrust, will prove of interest to mechanical men.

IN April 1917 the United States found itself with scores of enemy-owned ocean liners on its hands, the machinery of which had been damaged in an effort to render the vessels useless for an estimated period of at least eighteen months. Without these vessels, it would have been practically impossible for the United States to transport troops to France at a sufficiently rapid rate to turn the great stalemate into an overwhelming victory. Nevertheless, five months later most of these vessels were ready for service on the high seas, their engines humming and their propellers functioning as well as ever —some of them, it is said, even better than ever. A mechanical miracle had been performed. It is of the greatest interest to note that this engineering achievement would have been impossible fifteen years earlier. But for the development of the very recent arts of electric and oxy-acetylene welding, the broken cylinders of the former German liners could not have been repaired. The engines would have had to be entirely rebuilt, and as for their service during the war, it would have been better if these vessels had not existed. The electric arc and the oxy-acetylene flame manipulated by skilled workers restored the power of the mighty engines of these badly needed ships, and made it possible to place more than two million Americans on French soil within a year.

ELECTRIC arc welding requires skill, and to acquire this skill, training is necessary. This was recognized in the early part of the war by the General Electric Co., and a training school for electric welders was established at the Schenectady plant. When peace came, this school was reorganized for peaceful purposes, and having demonstrated its value, was enlarged and amplified. In this number of MACHINERY an account is given of the methods employed in teaching young men to become proficient arc welders. This is a new, skilled trade, unknown, as a trade at least, ten years ago. It is another step forward in the application of engineering science, and shows how the laboratory methods of the scientific investigator of a decade or two ago become the practical servants of mankind a generation later.

IT is a universal trait of mankind to endeavor to explain and label everything. One label, and a good one, is: "The Horseless Age." At first the horse was driven from city streets and country highways, as far as passenger traffic was concerned, and became altogether a "truck horse," as the saying is. Later, he began to disappear from trucking service, so that today, more loads are doubtless moved by motors than by horses. But on the farms the horse appeared to be indispensable. Even here, however, a great change is taking place. The farm tractor is supplanting the team of horses, and is doing their work quicker, better and cheaper. It is estimated that 200,000 tractors are being built in the United States this year. As these machines become more and more reliable and farmers learn how to handle them, their number will increase.

THE article "Special Machines in a Tractor Shop," in this number of MACHINERY gives a definite idea of this highly specialized new industry, and indicates how it is destined to develop along lines paralleling the amazing progress of the automobile industry.

The Machine Tool Industry

THE greatest difficulties in the industrial field at the present time are caused by the scarcity of coal and coke and the troubles experienced with the railroad freight service. As the scarcity of fuel is directly due to the transportation difficulty, the inability of the railroads to cope with the demands of the industries is really at the bottom of the most serious problems now facing the country in the manufacturing fields.

IN the machine tool industry there has been a marked falling off of orders, although all the machine tool builders are still busy. Present orders are not for as large numbers of machines as during the past nine months, but there are a great many small orders for one or a few machines each. The railroads are continuing to buy machine tools, and have placed fair-sized orders during the past month. It is expected that there will be an increase in orders just as soon as machine tool builders are able to quote on earlier deliveries, but buyers seem to be reluctant to place orders for tools so many months ahead as was necessary during the first half of the year.

THE foreign trade in machine tools and other metal-working machinery fell off considerably during the first months of the year, due almost entirely to the adverse influence of the foreign exchange. During the past month there has been a fair amount of foreign business, and the complete statistics of the Department of Commerce for the month of May, which have just been published, indicate that there was a slight improvement in that month in the export trade of machine tools as compared with the month of April. During the month of May, machine tools to a value of about $2,425,000 were exported, as compared with $2,100,000 during the month of April. There was also a decided improvement in the exports of metal-working machinery other than machine tools. The exports in this class of machinery were represented by less than $1,500,000 in April, as compared with over $1,900,000 in May. The total metal-working machinery exports for the month of May amounted to nearly $4,350,000, which is considerably above the exports during any of the preceding months of the year.

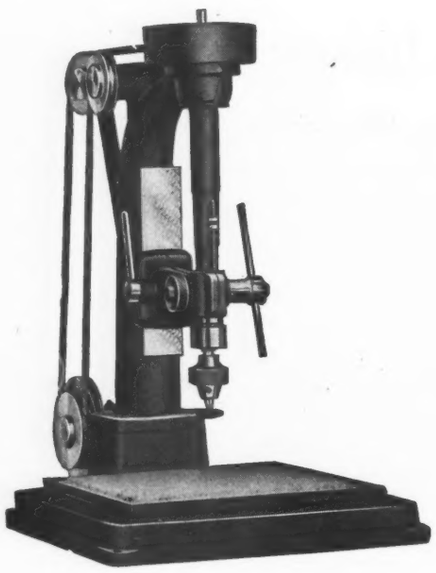
ENGLAND still represents our largest customer for machine tools, the exports of machine tools to that country in May being valued at over $750,000, while the exports of other metal-working machinery to England were valued at nearly $575,000. France imported nearly $375,000 worth of machine tools and $234,000 worth of other metal-working machinery. China imported $27,000 worth of lathes, and nearly $9000 worth of other machine tools, which is significant.

THE Department of Commerce has officially announced the resumption of trade with Russia; but it is not likely that there will be any trade in machine tools of any importance with Russia until that country has settled down to more normal conditions.

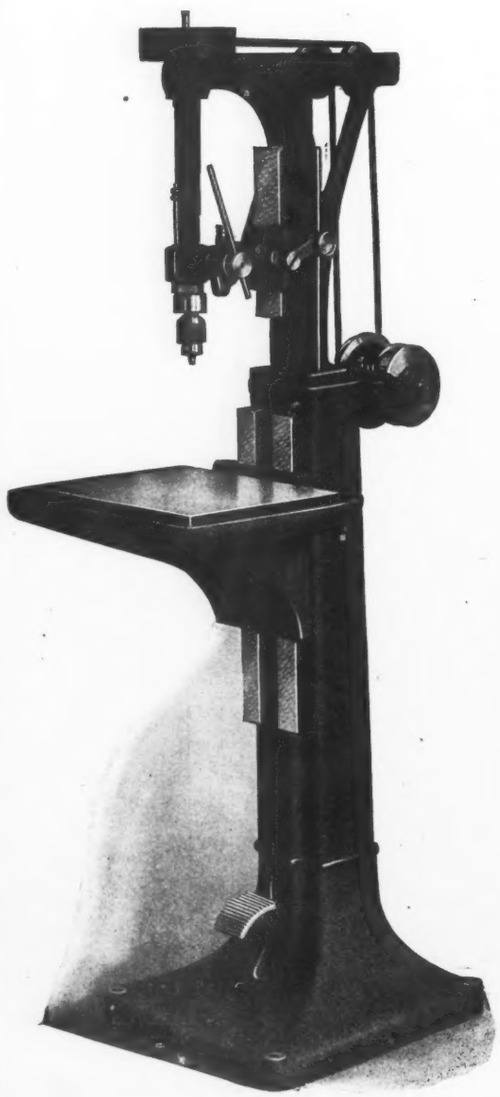
THE labor situation has improved somewhat recently. In many of the leading industries manufacturers have found it advisable to reduce their force on account of the smaller volume of business. This condition has indicated to the workers that the industries cannot indefinitely maintain high wages, often coupled with curtailed output on the part of the worker, and it has been reported in several instances that the more intelligent among the men in the shops have come to understand the necessity for maintaining output in order to prevent prices from mounting still higher and the industrial prosperity of the last few years from coming to an end.

EXPORTS OF METAL-WORKING MACHINERY FROM THE UNITED STATES, MAY, 1920

Countries	Lathes, Dollars	Sharpening and Grinding Machines, Dollars	Other Machine Tools, Dollars	All Other Metal-Working Machinery, Dollars
Belgium	29,148	14,732	67,689	96,452
Czechoslovakia	.....	1,678	.....	.....
Denmark	5,147	9,317	7,914	.....
Finland	.....	.....	1,998	.....
France	75,499	68,917	230,167	234,423
Germany	.....	790	6,890	6,542
Greece	725	.....	3,942	1,412
Iceland and Faroe Islands	.....	52	.....	.....
Italy	24,685	8,604	107,397	168,470
Netherlands	5,702	1,230	1,875	2,243
Norway	.....	860	2,466	9,823
Poland and Danzig	.....	1,500	.....	.....
Portugal	3,403	37	3,190	.....
Roumania	4,733	825	2,348	8,015
Spain	59,940	4,158	18,807	30,279
Sweden	13,941	10,682	15,028	3,647
Switzerland	198	.....	13,456	11,002
Turkey in Europe	.....	.....	651	.....
England	246,812	67,202	445,605	574,513
Scotland	.....	444	10,613	3,640
Ireland	.....	733	2,803	13,976
Bermuda	.....	250	314	.....
Canada	90,665	26,943	140,893	207,941
Costa Rica	.....	444	3,251	.....
Guatemala	.....	.....	116	.....
Honduras	.....	.....	638	.....
Nicaragua	.....	.....	484	.....
Panama	300	15	174	6,175
Salvador	.....	22	.....	.....
Mexico	18,179	3,339	7,665	15,863
Miquelon, Langley, etc	1,050	.....	.....	.....
Newfoundland and Labrador	2,550	.....	.....	170
Barbados	.....	.....	7	.....
Jamaica	56	105	.....	.....
Trinidad and Tobago	112	.....	378	.....
Other British West Indies	106	.....	45	.....
Cuba	24,656	3,519	24,068	24,497
Dutch West Indies	.....	.....	100	.....
French West Indies	.....	.....	85	.....
Haiti	.....	307	.....	.....
Dominican Republic	2,250	360	281	1,454
Argentina	13,140	706	8,848	15,161
Bolivia	650	500	171	1,440
Brazil	12,763	1,944	20,473	3,115
Chile	519	172	3,377	1,171
Colombia	4,631	228	7,590	2,213
Ecuador	935	.....	51	.....
British Guiana	.....	.....	312	.....
Paraguay	.....	.....	358	.....
Peru	6,027	2,592	7,019	5,838
Uruguay	1,700	26	1,098	.....
Venezuela	2,324	330	606	466
China	27,052	2,700	6,202	35,722
Kwantung	.....	1,255	.....	4,000
British India	46,106	1,237	23,386	104,788
Straits Settlements	.....	103	490	2,104
Other British East Indies	.....	22	.....	.....
Dutch East Indies	2,241	4,657	1,159	4,279
Hongkong	.....	595	572	.....
Japan	61,518	15,690	66,182	271,640
Turkey in Asia	3,300	.....	150	.....
Australia	5,517	10,658	30,217	10,896
New Zealand	6,212	1,036	3,924	1,093
French Oceania	.....	.....	.....	965
Philippine Islands	9,522	1,565	2,955	21,104
Belgian Kongo	4,944	.....	.....	.....
British West Africa	30	.....	.....	.....
British South Africa	5,159	1,818	11,086	9,451
British East Africa	.....	.....	566	.....
French Africa	787	.....	.....	.....
Portuguese Africa	3,650	108	348	1,867
Egypt	850	1,050	.....	1,571
Total	829,434	276,057	1,318,478	1,919,421



Bulletin No. 502 gives details



Would You Increase Your Drilling Production?

Leland-Gifford 10,000 R. P. M. Ball Bearing Drilling Machines will help you do this on holes up to 3/8" diameter.

BECAUSE they have the speed, sensitiveness and rigidity necessary for the fast drilling and handling of small parts, and

BECAUSE they are dependable, durable and accurate.

Built in Bench or Floor Type. 1 to 6 spindles. Hand or Foot Feed.

Can be furnished with Tapping Attachments and Multiple Heads if desired.

LELAND-GIFFORD COMPANY

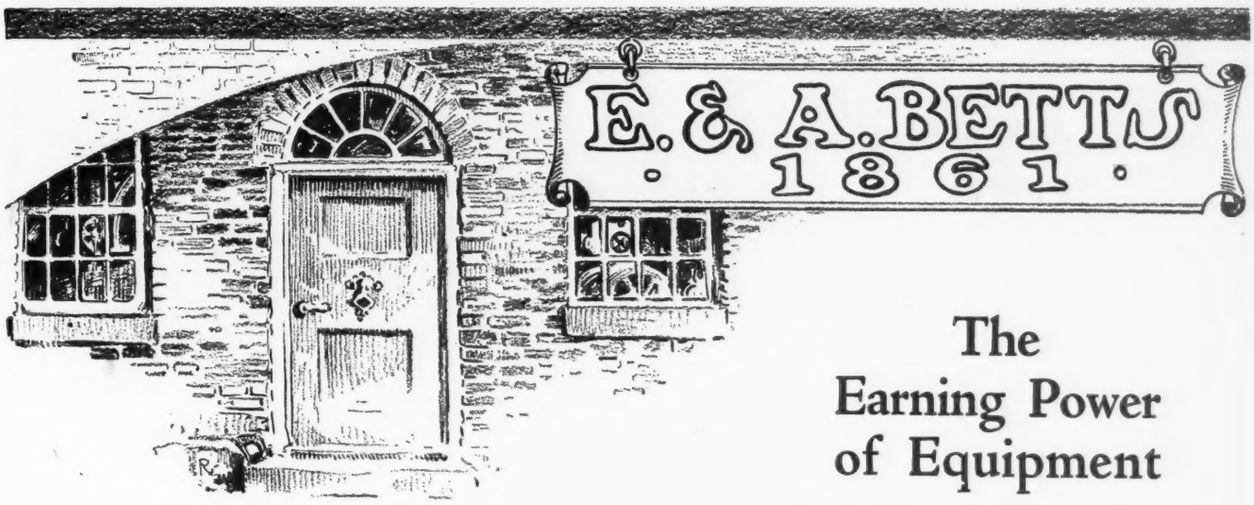
WORCESTER MASS., U. S. A.

BRANCH OFFICES:

NEW YORK CHICAGO BOSTON DETROIT ROCHESTER

DOMESTIC AGENTS:

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Swind Machinery Co., ...	PHILADELPHIA
Somers, Fitler & Todd	PITTSBURGH
F. E. Satterlee Co.	MINNEAPOLIS



The
Earning Power
of Equipment

BETTS-BRIDGEFORD

Heavy Duty Geared Head Engine Lathe

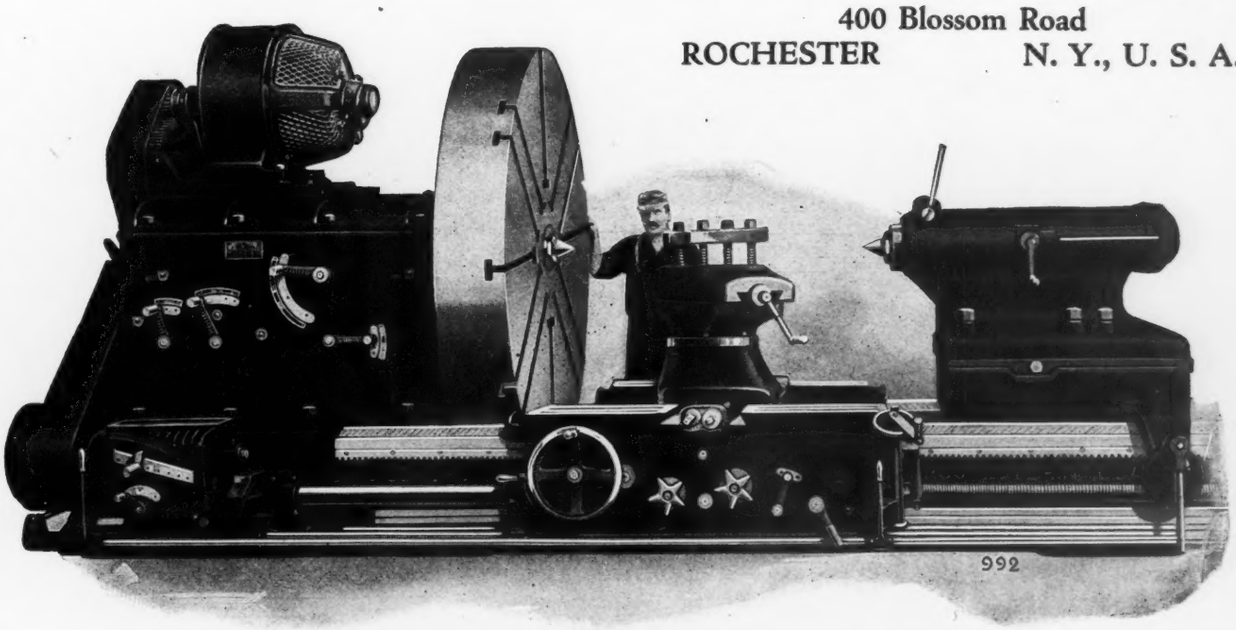
The value of the work done on machine tools is infinitely greater than that of the tools themselves.

The cost of such tools is negligible, therefore, compared to their ability to accomplish.

The record of satisfactory accomplishment for Betts-Bridgeford Heavy Duty Machine Tools covers a period of some sixty years. Since the year 1861 they have demonstrated their remarkable earning power in many widely varying industries in all parts of the world.

Write for Catalog

BETTS MACHINE CO.
400 Blossom Road
ROCHESTER N. Y., U. S. A.



N-B-P RIGHT LINE

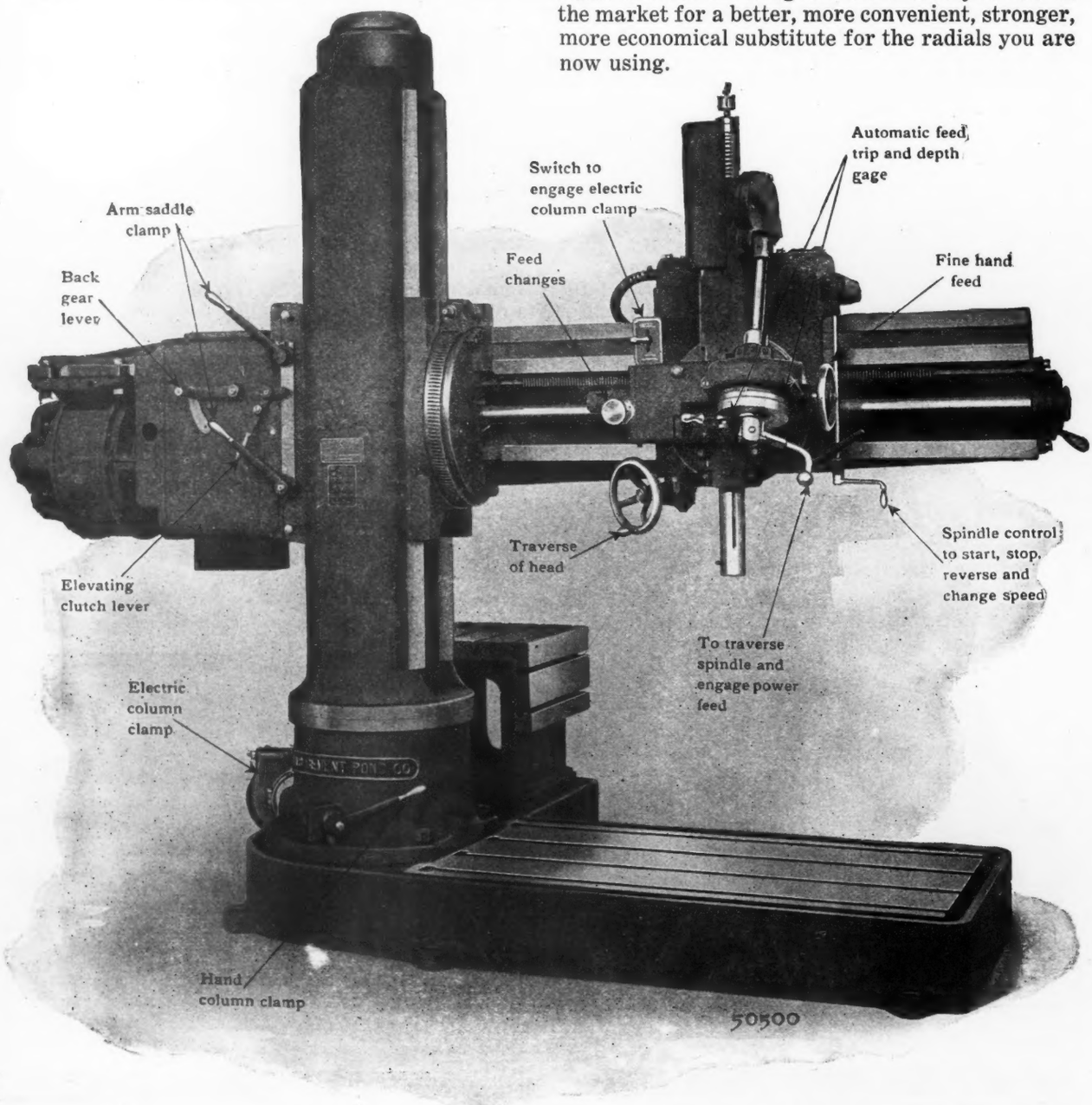
A Radical Advance in Drill Design

SOMEONE recently asked us why we called this new drill of ours the *RIGHT LINE* Radial. There are two very good reasons for this name, and a slight examination of the drill will suffice to make them clear.

The machine, first of all, is correct, that is *right*, in design—its proportions please the eye, they bespeak strength and stamina in every part; it is *right* in construction; it is *right* in the simplicity, ease, convenience and safety of its operation controls.

Again, a *right line* being the shortest distance between two points, this word most clearly describes the distinguishing feature of this drill, the direct drive from motor to spindle made possible by the double column construction.

Hence *RIGHT LINE* Radial Drill—remember the name and its meaning the next time you are in the market for a better, more convenient, stronger, more economical substitute for the radials you are now using.



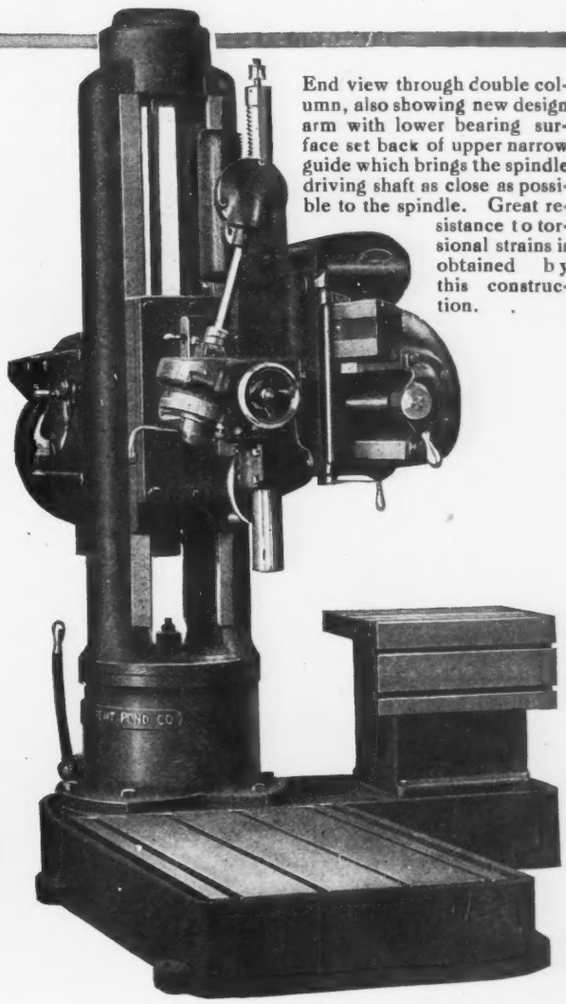
MOTOR DRIVEN RADIAL DRILLS

With Direct Drive Through the Column From Motor to Spindle

BY using a double column, by mounting the motor at the end of saddle arm and driving through column, the simplest, most direct drive from motor to spindle is obtained. Two-thirds of the usual driving gears and countershafting are eliminated, and a saving of 25 percent of the power ordinarily lost in friction is accomplished. *The drive diagrams below tell the story.*

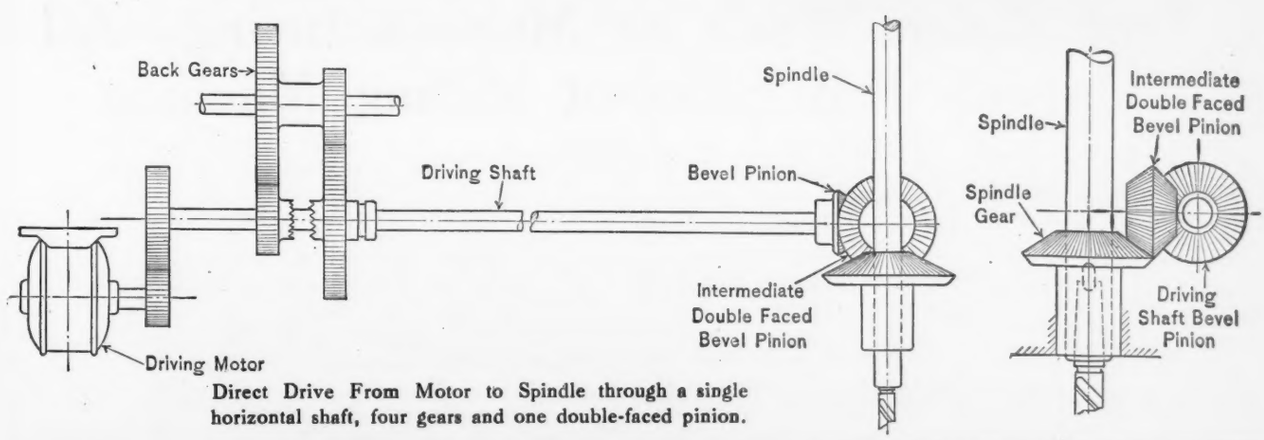
The entire column rotates on ball bearings and swings with the arm, an unusual idea that is the secret of the remarkable rigidity of this drill. Bending stresses in the column are *always* in the direction of its greatest strength.

Simplicity is the keynote of the control equipment. Note the detailed photograph opposite. From his position at the drillhead, the operator can control all movements. One convenient lever starts, stops and reverses or varies the speed of spindle, another traverses spindle and engages power feed. Fine hand feed, traverse of head, the feed change dial, the automatic feed trip and depth gauge are all within arm's reach, as is also the switch operating the electric column clamps.



End view through double column, also showing new design arm with lower bearing surface set back of upper narrow guide which brings the spindle driving shaft as close as possible to the spindle. Great resistance to torsional strains is obtained by this construction.

The new N-B-P RIGHT LINE Radial Drill is described in detail in our catalogue just off the press. Your copy is waiting.



Direct Drive From Motor to Spindle through a single horizontal shaft, four gears and one double-faced pinion.

NILES-BEMENT-POND COMPANY

GENERAL OFFICES: 111 BROADWAY, NEW YORK

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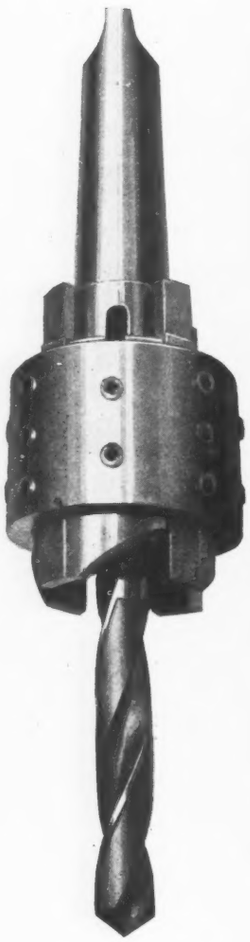
ROCHESTER
CINCINNATI
PITTSBURGH

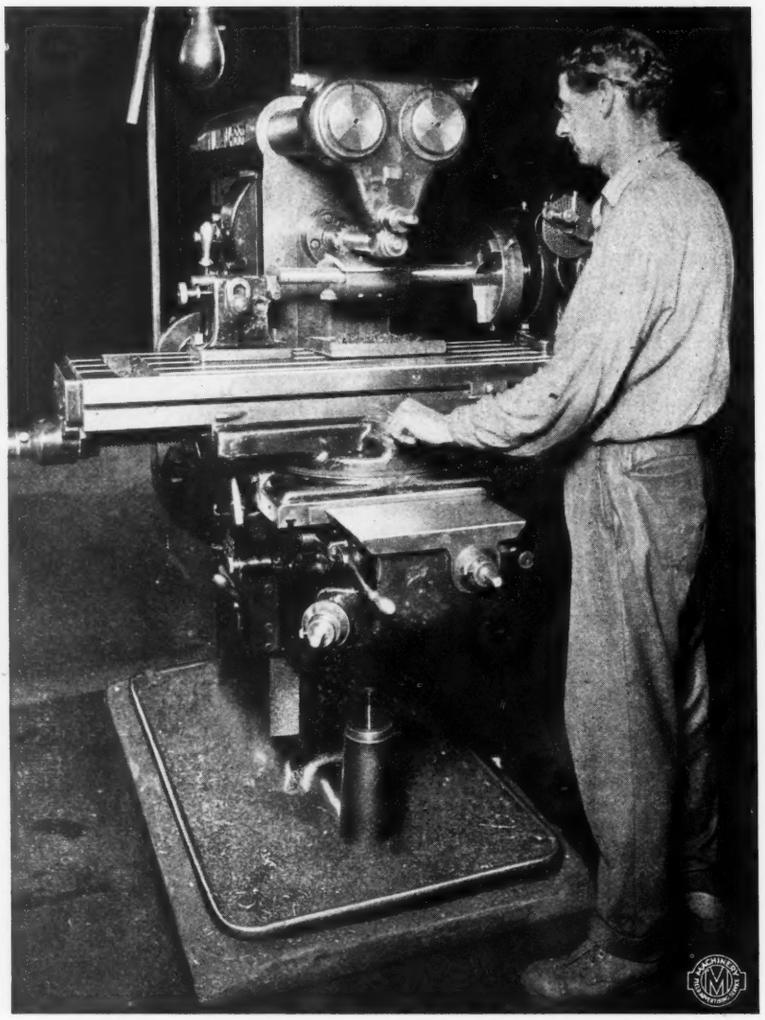
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Milwaukee Milling Machines





Tool Room Work or Manufacturing—All One to This Efficient Milling Machine

This Milwaukee Milling Machine was chosen for general use—and *that* in this shop includes everything from fine tool work to roughing cuts on the heaviest castings within the capacity of the machine.

The illustration shows a highly accurate tool-making operation—the manufacture of a special cutter on which all milling work is done on this machine, which is seen taking a cut 1″ wide and 7′ 16″ deep at one stroke.

The double overarm, flanged spindle, solid top, box section knee and generally rigid and accurate construction of these machines insure long and satisfactory service with minimum repairs. For instance, the Milwaukee Milling Machine shown here has been in constant use for over three years with *no repairs*.

Our Catalog describes these machines in detail. Send for it.

KEARNEY & TRECKER CO. MILWAUKEE., WIS., U.S.A.

NEW YORK OFFICE: 1801 Singer Bldg.
CLEVELAND OFFICE: 738 Superior Ave., N. W.
CHICAGO OFFICE: 631 Washington Blvd.

THE OTHER DAY—

an apron from a lathe built by us over 21 years ago was sent in to be overhauled.

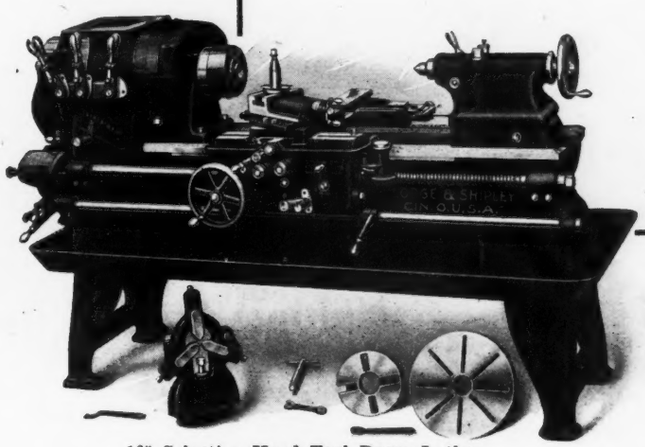
Not that this is really anything out of the ordinary but this particular order serves exactly as an example of the durability and stamina which is built into every LODGE & SHIPLEY Lathe.

The owner states he is more than satisfied with the lathe and the only wear shown is in the apron, which is to be expected.

How many lathes are in good condition after having been run twenty years? The life of a majority is only half that time, yet here is one which the owner is confident will render years of additional service with only the apron being overhauled. *What recommendation could be more convincing?*

If you are considering the purchase of a good lathe, one that is a real investment and which you can rest assured will give satisfaction for many years to come, we invite your further investigation of

LODGE & SHIPLEY



16" Selective Head Tool Room Lathe.
EQUIPMENT INCLUDES
Draw-in Chuck Without Collets.
Pan. Taper Attachment.
Manufactured in sizes 14" to 20".

Engine Lathes
Manufacturing Lathes
Tool Room Lathes

THE LODGE & SHIPLEY MACHINE TOOL CO.
CINCINNATI OHIO



Some Day These Parts May Be Under Your Car

This photograph shows a Baush application in one of the latest developments of the automobile field—the Disteel wheel. Twelve ¾" holes are drilled through 3/16" steel in this particular wheel; twenty wheels being turned out per hour.

Baush Multiple Spindle Drills are used for other operations in the construction of Disteel wheels, such as drilling for rivets, etc. The growing popularity of these wheels has taxed the factory to the utmost, and the wonderful production possibilities of the Baush Drill are greatly appreciated.

BAUSH

Multiple Spindle Drills

Let us send you full particulars

BAUSH MACHINE TOOL CO. *Detroit Office 1825 Dime Savings Bank Bldg.* **SPRINGFIELD, MASS., U. S. A.**

Manufacturers of Multiple Spindle, Horizontal and Radial Drills

Domestic Representatives:
Manning, Maxwell & Moore, Inc. Motch & Merryweather Mchy. Co.

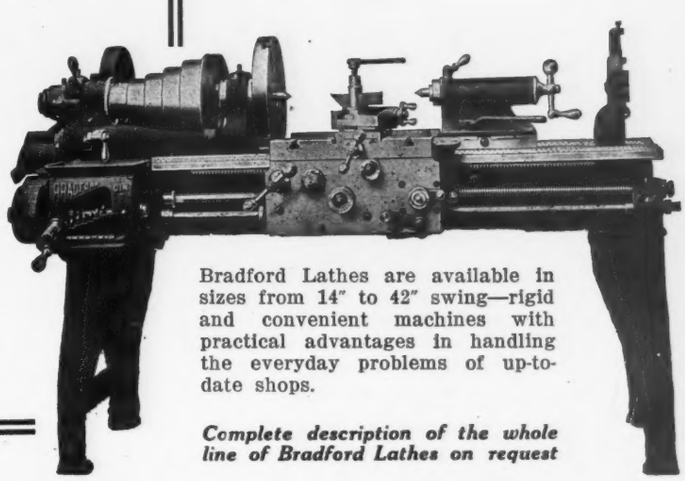
Foreign Representatives:
Alfred Herbert, Ltd., Coventry, England. Fenwick Freres & Co., Paris, France



Not a "War Baby" But a Pioneer in Standardized Lathes

Bradford, the super-production lathe, is not a by-product of the World War, not a "War Baby," but a tried and true pioneer in standardized lathe manufacture. There are no half-baked theories in Bradford's sturdy construction, no untried ideas—just a practical and proven design that has stood up year in and year out and rendered the best of service to users in all parts of the country.

The accompanying photograph shows one of the two 24″ Bradford Lathes installed at the Dayton Pump & Manufacturing Company. The operation is boring, turning and facing the end of a cast-iron gasoline pump body. It is interesting to note that the casting is chucked by its base, and the outer end is 28″ from the chuck and entirely unsupported.

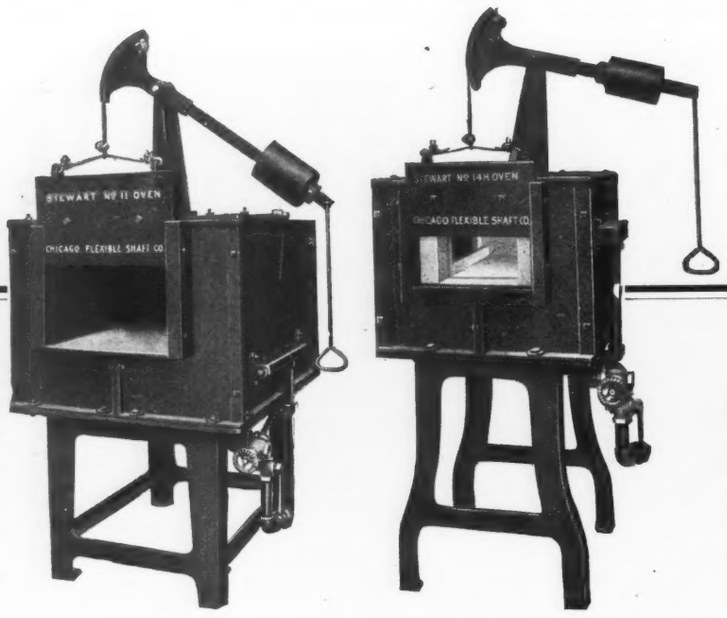


Bradford Lathes are available in sizes from 14″ to 42″ swing—rigid and convenient machines with practical advantages in handling the everyday problems of up-to-date shops.

Complete description of the whole line of Bradford Lathes on request

BRADFORD MACHINE TOOL CO., CINCINNATI OHIO, U. S. A.

AGENTS: Swind Machinery Co., Philadelphia. Taylor Machinery Co., Boston, Mass. Stocker-Rumely-Wachs Co., Chicago, Ill. Somers, Fitler & Todd Co., Pittsburgh, Pa. The E. A. Kinsey Co., Cincinnati, O., and Indianapolis, Ind. The Mine & Smelter Supply Co., Denver, Colorado. Pacific Tool & Supply Co., San Francisco, Cal. Ogden R. Adams, Rochester, New York. Ralph B. Bowman, St. Louis, Mo. W. J. Baird Mchy. Co., Detroit, Mich. McMullen Mchy. Co., Grand Rapids, Mich. Patterson, Gottfried & Hunter, Inc., New York City. The Biggs-Watterson Co., Cleveland, O. Northern Machinery Co., Minneapolis and Duluth, Minn.



STEWART No. 11 OVEN FURNACE

For Annealing, Carbonizing, Hardening Carbon Steel, Heat-treating, Pre-heating or Re-heating.

Specifications

Opening, 12" x 20".
Depth, 36".
Floor space, 42" x 54".
Gas and air connections, 1½".
Shipping weight, 3,500 lbs.
For gas or oil fuel.

STEWART No. 14-H OVEN FURNACE
For High Speed Steel

Burners on left side enter underneath bottom slab same as in regular oven, but opposite burners enter in heating space, making equipment under and over fed.

Specifications

Opening, 6" x 10"; depth, 15".
Floor space, 36" x 36".
Gas and air connections, 1¼".
Shipping weight, 1450 lbs.
For gas fuel only.
Four other stock sizes.

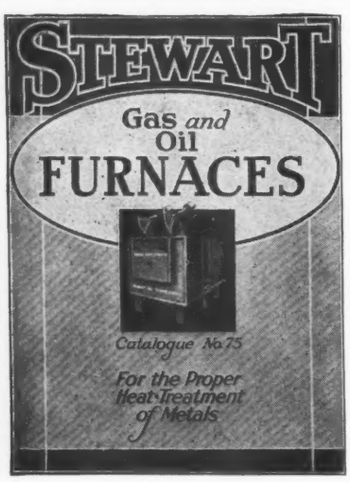
"Sure! Heat to 1400 and Quench It"

John, the foreman, told Harry that just yesterday, and that gear still comes out soft and warped. Says John: "Bum lot of steel, I guess. Better get a new brand—send to Marks and get some of Blank's steel, and we'll try it. It's more expensive, but we've got to get those machines off the floor this week."

Ever hear this before? It happens daily in many a shop, and is an expensive process for some one—experimenting usually is. And with it go all the profits.

Have Catalog No. 75 for Ready Reference

80 large pages, attractively illustrated, thoroughly describing Stewart Furnaces. Forges and Heat-treating Equipment. Valuable heat-treating information. You should have this catalog convenient for reference.



Our Service May Help Your Difficulties

In the manufacture of Stewart Furnaces the Chicago Flexible Shaft Company has a staff of trained metallurgists who are at your service on any job you may have trouble with.

"Something is radically wrong with the steel" is "bum logic"—it's generally the heat-treating process that's at fault.

Don't be backward about telling us your troubles. Our metallurgists are no wizards, but their special training is worth money to you—avail yourself of it.

There's a Stewart Furnace for every heat-treating requirement

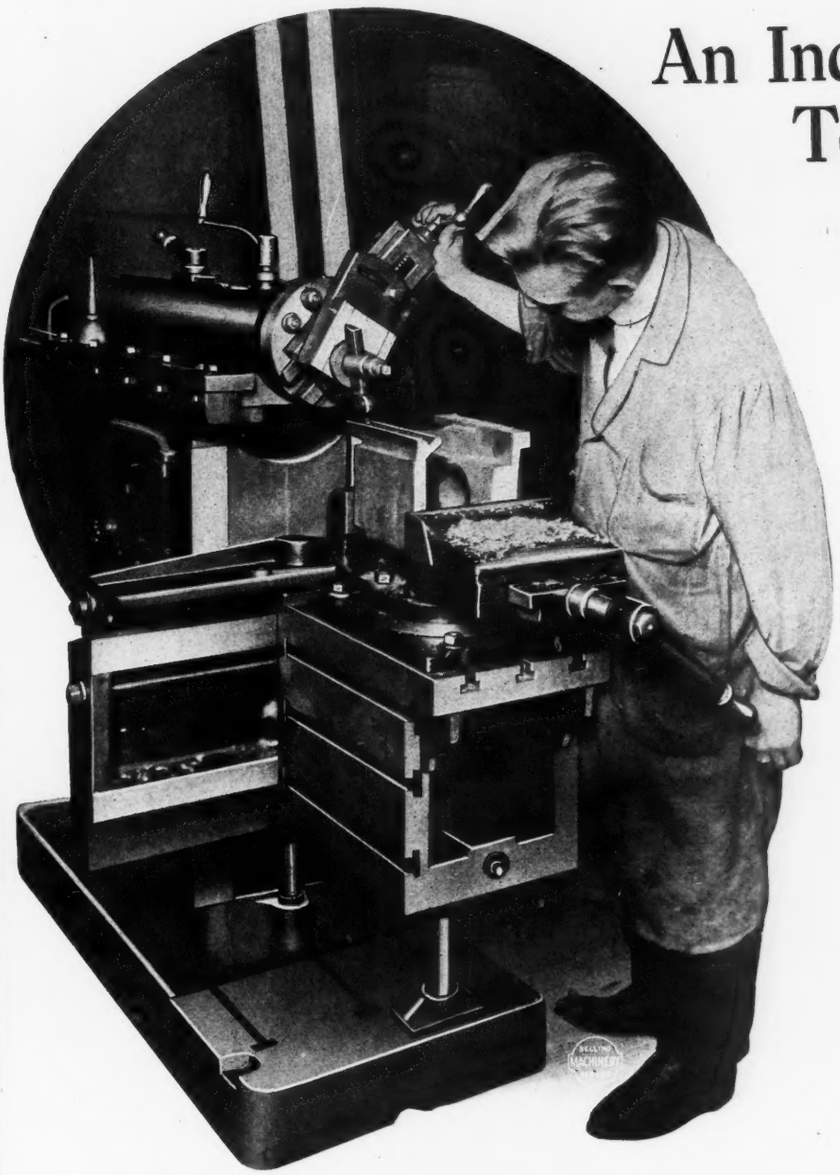
CHICAGO FLEXIBLE SHAFT COMPANY

1154 S. Central Avenue, Chicago

350 Broadway, New York **Railway Exchange Bldg., St. Louis**

OHIO SHAPERS

An Indispensable Tool for the Contract Shop



You can't set up a contract shop and do a successful business unless you are equipped to handle more difficult work, do speedier work and make a better job of it than the men you are doing the work for.

The accompanying photograph taken in the shops of the Springfield Tool Co., Springfield, Mass., shows an Ohio Shaper on the job in a place which makes more than ordinary demands on equipment.

Heavy and intricate parts on which close limits must be maintained, pass in succession through their machining operations on the "Ohio."

Ohio Shapers are made in sizes ranging from 14″ to 28″ — Standard and Heavy Duty Types. They will handle a wide range of work.

We'll be glad to know your shaper problems, and to cooperate with you in their solution. Give us the opportunity.

OHIO MACHINE TOOL CO.

Planers and Shapers Since 1887

KENTON **OHIO, U. S. A.**

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The Davis Close Coupled Lathe

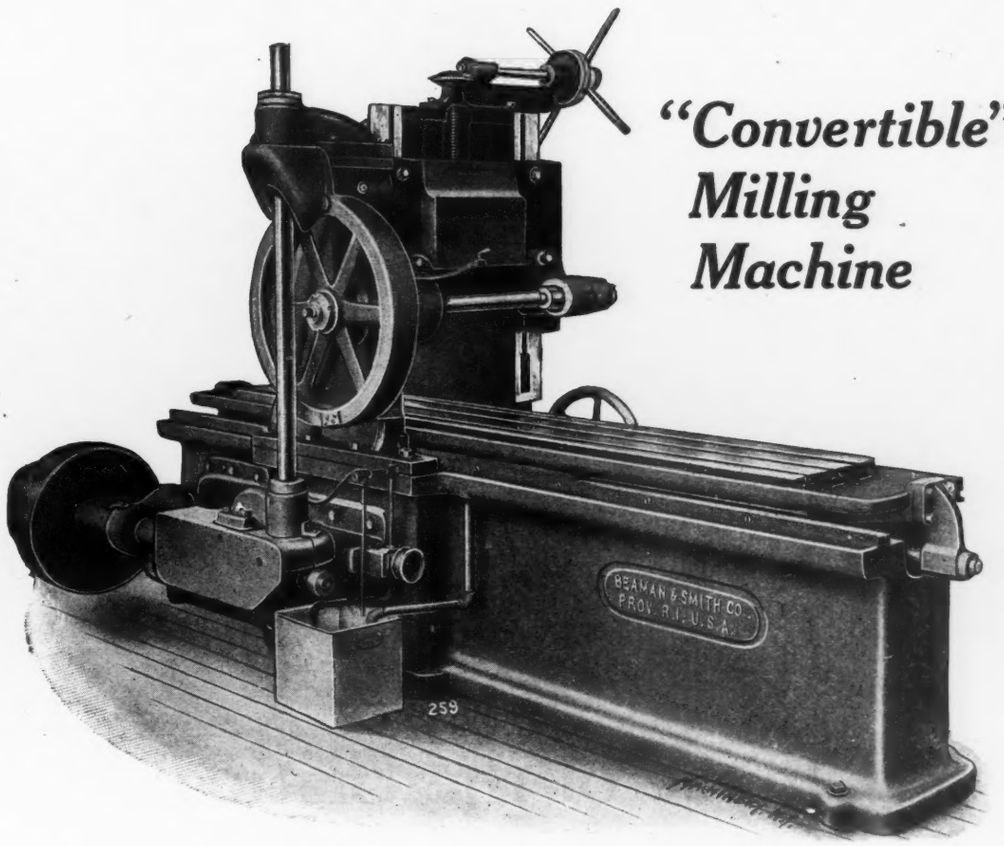
ACCURACY

"Accuracy" describes the Davis Close-Coupled Lathe in one word. A year ago the Metallic Gasket Company of New Brunswick, N. J., purchased a "Davis." After the machine had been in operation for some time, they found it so accurate they reserved it for the very best work only. Ordinary work now goes to other lathes. The coarsest operation on this lathe is to a tolerance of plus or minus .002".

It will pay you to get full details. Write us to-day.

DAVIS MACHINE TOOL COMPANY, Inc.
ROCHESTER **NEW YORK, U. S. A.**

BEAMAN & SMITH



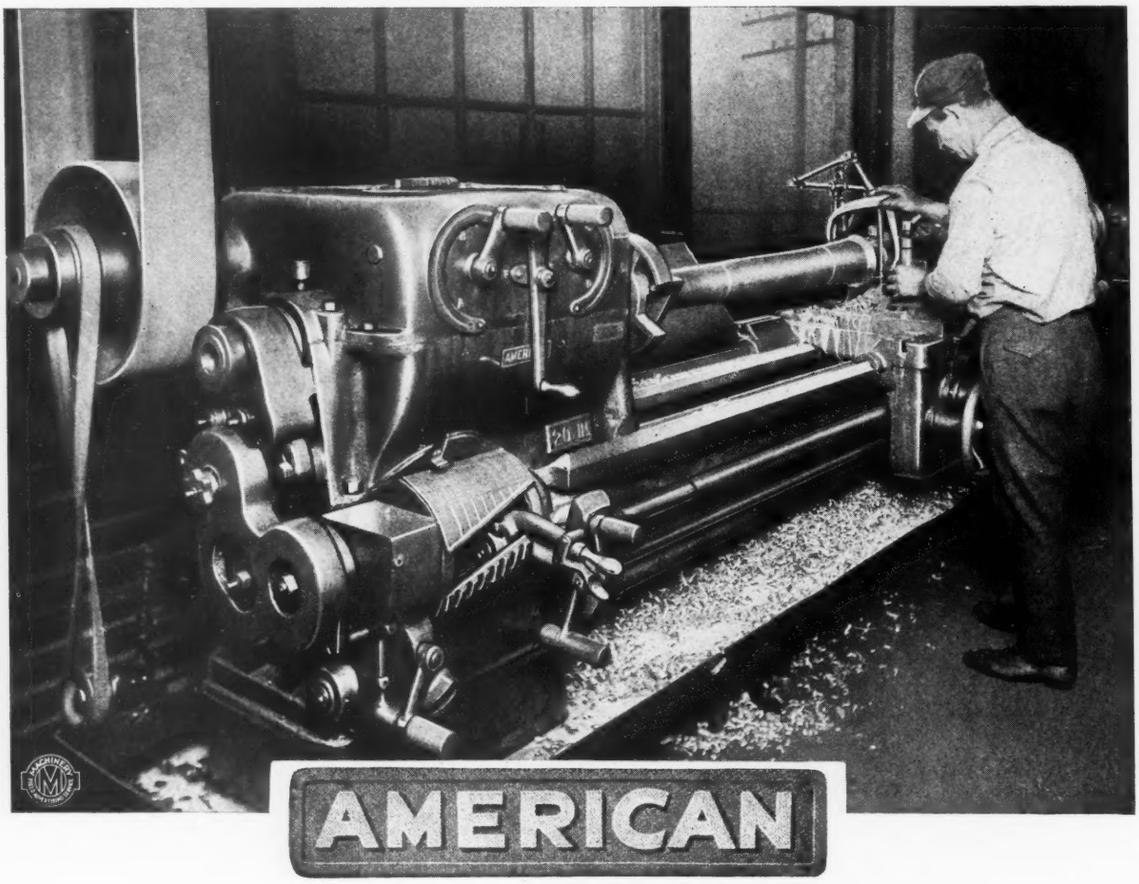
"Convertible" Milling Machine

THIS No. 1 B & S is classified as a horizontal spindle milling machine. An extra attachment can be furnished, however, which turns it into an efficient vertical miller. The horizontal spindle has horizontal adjustment and 17″ vertical movement. The vertical spindle when in use is carried on the cross-head on which it travels horizontally and has vertical adjustment in the saddle. The machine carries cutters up to 8½″ diameter and takes unusually heavy cuts. An adjustable dial graduated to thousandths provides for cutting to any desired depth. Table is 14″ wide, 8′ long, and has quick power movement of 8′ to 15′ per minute in either direction and 8½′ movement on bed. Nine changes of feed are available, ⅝″ to 7½″ per minute at any spindle speed. Simple, rigid, high powered, this machine is an accurate, rapid, economical producer.

Investigate B & S machines for anything in boring, milling, drilling, tapping. Cost and production problems our special field.

BEAMAN & SMITH COMPANY

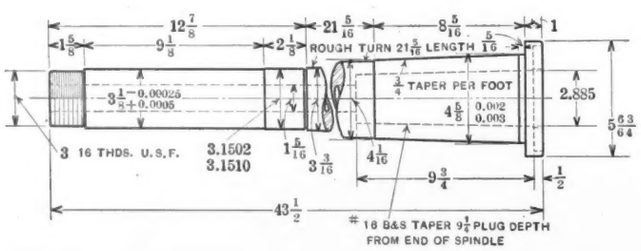
PROVIDENCE **RHODE ISLAND**



Choice of the Critical

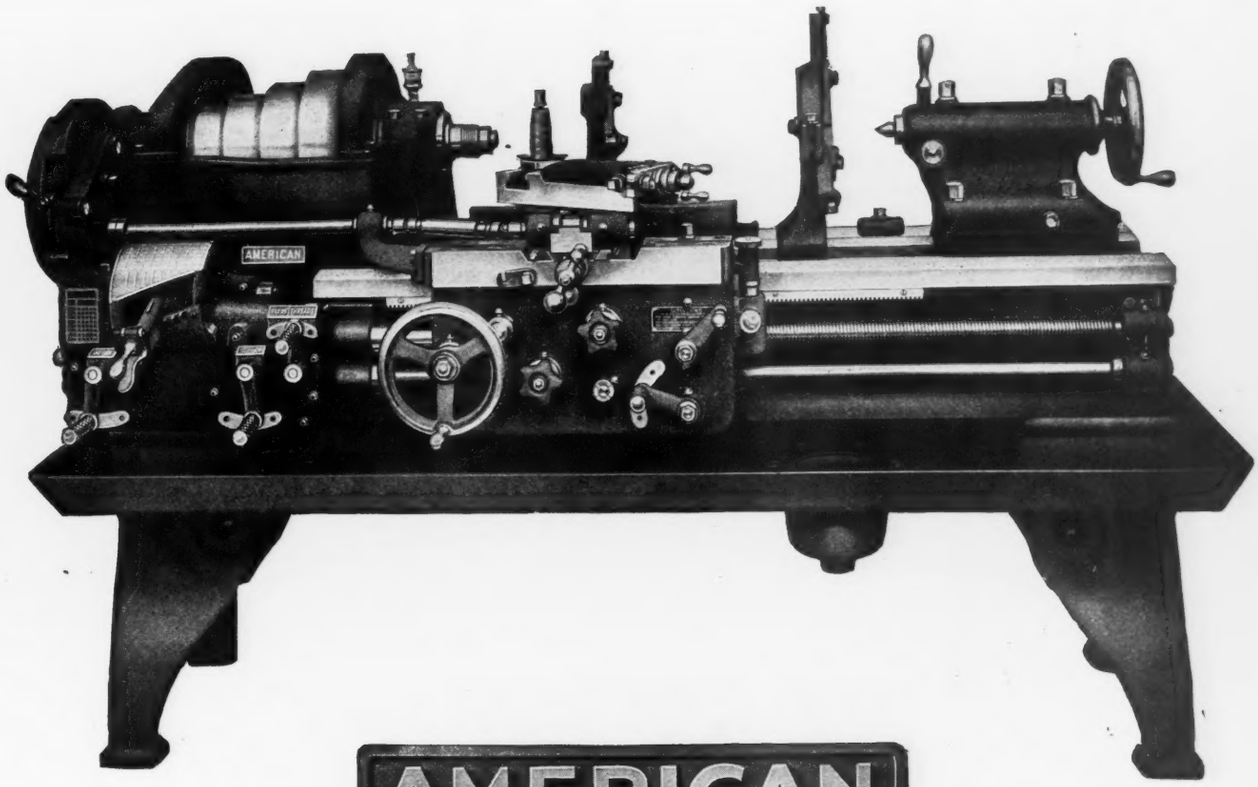
The new Ohio Miller, a highly developed 40″ Rotary which the Oesterlein Machine Company of Cincinnati, Ohio, has recently put on the market, is a powerful and highly accurate machine—the culmination of more than 40 years' experience. Only the best equipment is used to machine its many parts, which are made interchangeable and of the best material.

The spindle, for example, is a .40 carbon steel forging, weighing about 200 pounds in the rough, and to the five-year-old American Lathe here shown is assigned the responsibility of turning it ready for finish grinding. The operations, which include turning, tapering, boring, reaming and facing—9 operations in all—are clearly specified on the accompanying sketch. Production is 35 minutes per piece, *including handling time.*



THE AMERICAN TOOL WORKS

LATHES **PLANERS**



AMERICAN

As Good as the Best—and Then Some

American Lathes are always picked for the particular jobs wherever they are installed; and they are installed wherever manufacturers have learned by experience to appreciate the value of "quality" equipment. Heavy duty or toolroom styles—you will find whole batteries of them in the most progressive and up-to-date shops—the ultimate in power, speed, accuracy and operating convenience.

In common with all American Lathes the toolroom machine has patent drop vee bed and double plate apron, all bearings have renewable bronze bushings and every loose running gear is lined with phosphor bronze. Equipment includes Draw-in Collet Chuck, Taper Attachment, Plain or Universal Relieving Attachments, Compound Rest, Pan and Quick Change Feeding and Thread Cutting Mechanisms.

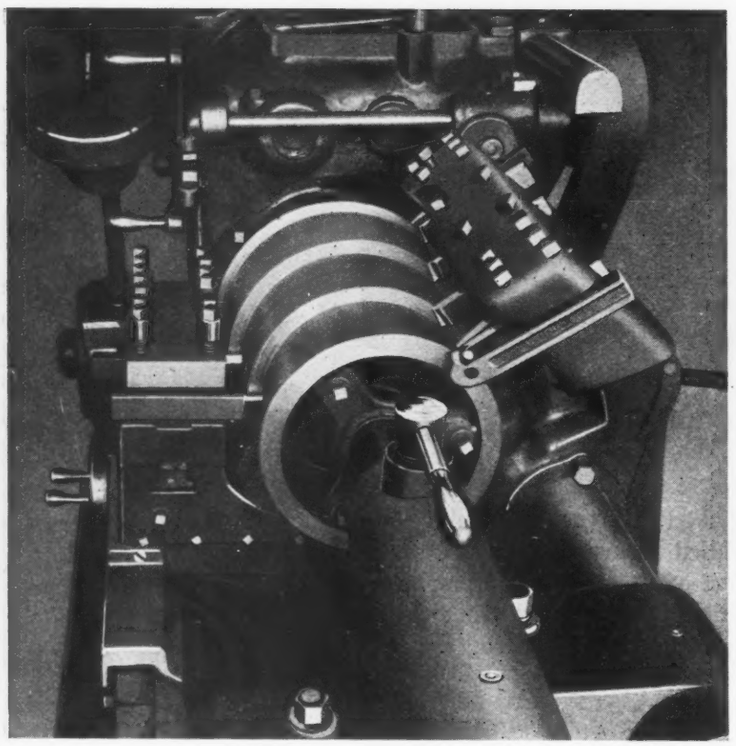
Exclusive advantages of American Toolroom Lathes are all fully described in the catalog which lists the whole line.

COMPANY, Cincinnati, Ohio, U.S.A.

SHAPERS **RADIALS**

FAY AUTOM

You Have the Work



The Pulley shown in the photograph is a 3-Step Flange Pulley being done in the plant of the Fellows Gear Shaper Company, Springfield, Vermont.

The superintendent tells us that this is the most satisfactory machine that he has ever had on this kind of work.

All turning and facing cuts are taken simultaneously. The back arm rocks in as the front carriage moves forward.

Observe the multiple tooling.

The pulley is machined complete in the time it takes to turn one step.

All roughing and finishing cuts are taken simultaneously — two machines, one operator.

All crowned faces are turned by regular mechanism of machine— no special attachments are needed.

Especial attention is called to the size of the work, requiring great pulling power on the part of the machine.

The largest step is 12″ diameter. The widest face is 3⅜″. Production is 6 per hour. This is only one of the many jobs that can be done profitably on the Fay Automatic Lathe.

You have the work, we have the machine. Let's get together

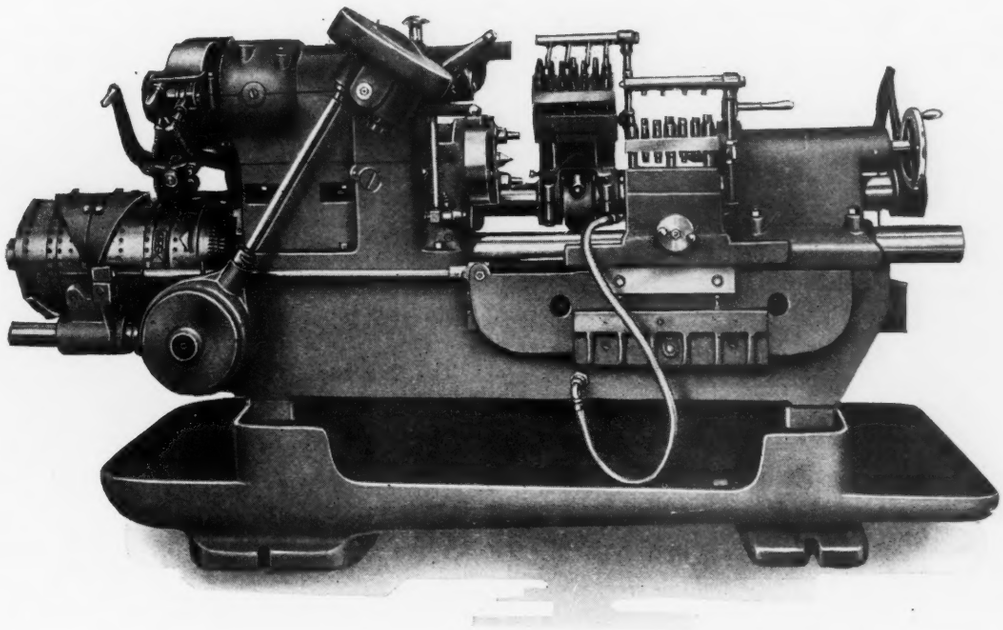
JONES & LAMSON

SPRINGFIELD, VERMONT, U. S. A.

503 Market Street, San Francisco, California. Paris, France: F. Auberty & Company, 91 Rue de Maubeuge.

ATIC LATHE

We Have the Machine



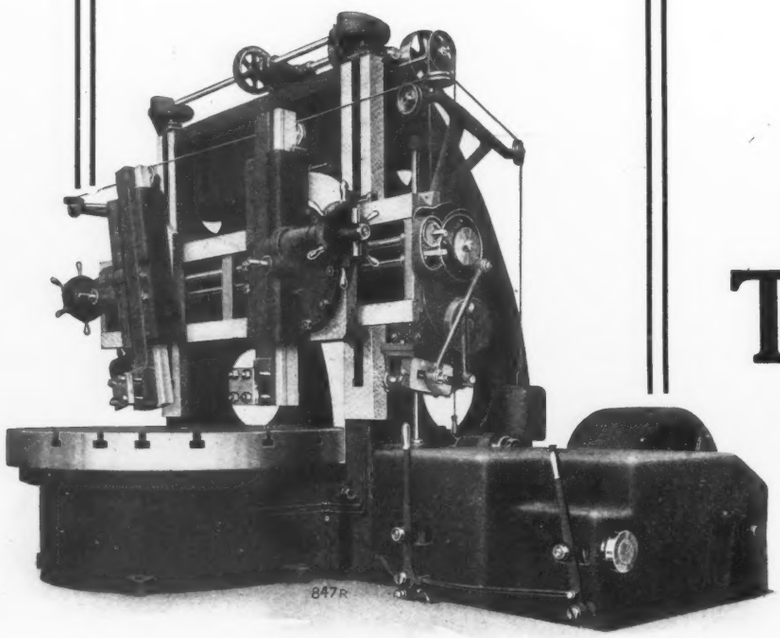
The heavy rigid construction of the Fay Lathe together with the design of multiple tool holders provided for both carriage and back arm, make it possible to use on the work all the tools that the rigidity of the work itself will permit. This is the limit with any form of machine.

Send for our Advanced Practice series. You are bound to find them interesting.

MACHINE COMPANY

9-10 Water Lane, Queen Victoria St., London, E. C.

Japan, Tokyo, Mitsui Bussan Kaisha, Ltd. Holland, Rotterdam, Spliethoff Beeuwkes & Co. Australia, Melbourne, McPherson Pty., Ltd., 554-588 Collins Street

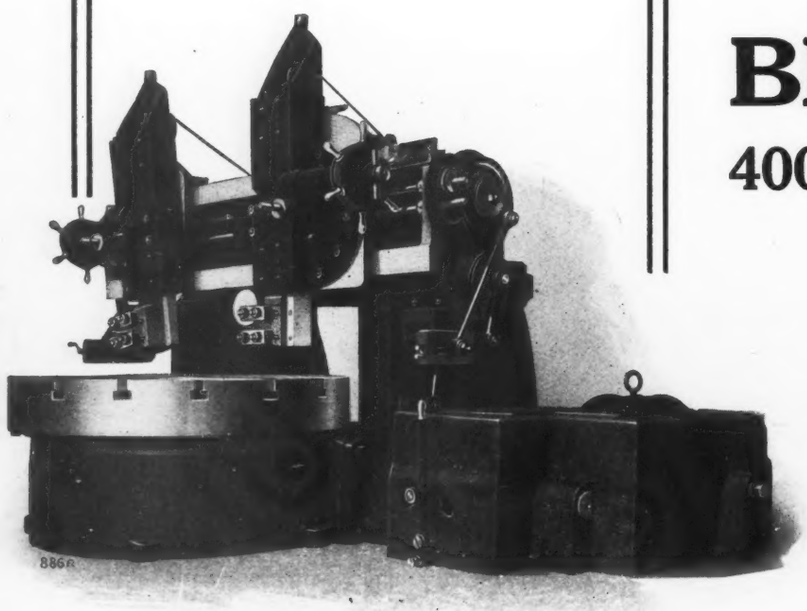


The Measu

Getting out the work; getting it out quickly, accurately, without a hitch or breakdown—these things are all that count today. Unreliable equipment may tie up hundreds, thousands, perhaps millions of dollars. A breakdown in machine tool equipment may delay the operation of an oil well, may tie up a mine, may stop a train, may close a factory.

Betts Heavy Duty Machine Tools have for nearly sixty years been the choice where conditions are unusually severe. They are always efficient, always reliable, invariably dependable — will

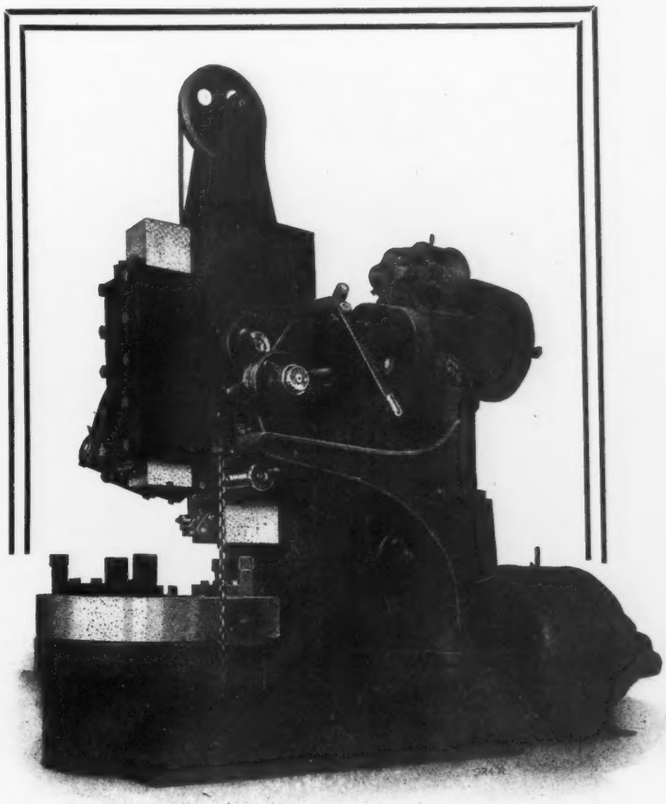
Planers
Boring and Turning Mills
Horizontal Boring, Drilling and Milling Machines
Tire Turning Mills
Car Wheel Borers
Slotters, Etc.



BETTS MA

400 Blossom Road

re of Value



handle with ease the overload of an emergency job. Betts Machine Tools go into remote parts of the country—to mines, wells, irrigation work, hydro-electric power plants. They are selected for this work because a breakdown in machine tool equipment might mean a long wait, a heavy loss.

Many of the best engineers throughout the world specify Betts Machine Tools, for the name "Betts" has come to be accepted as a guaranty of reliable performance under all kinds and conditions of work.

Engine Lathes
Axle Lathes

Journal Truing Lathes

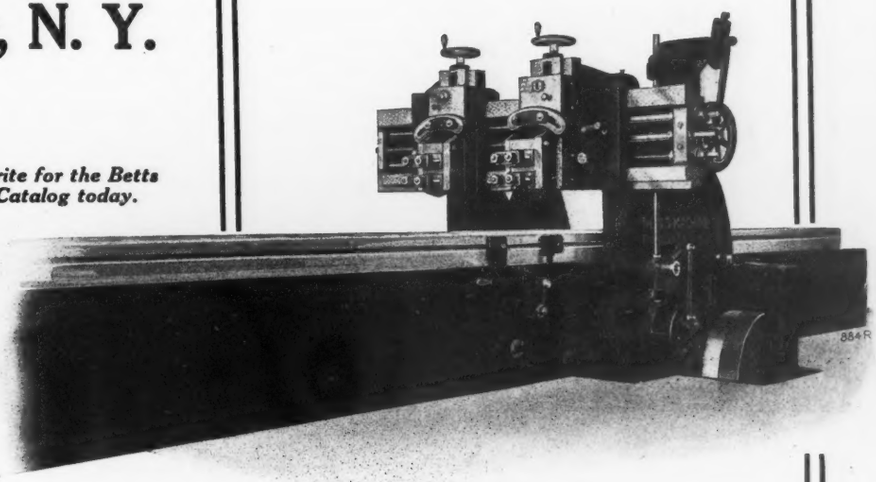
Coach and Driving Wheel Lathes

Oil Country Lathes

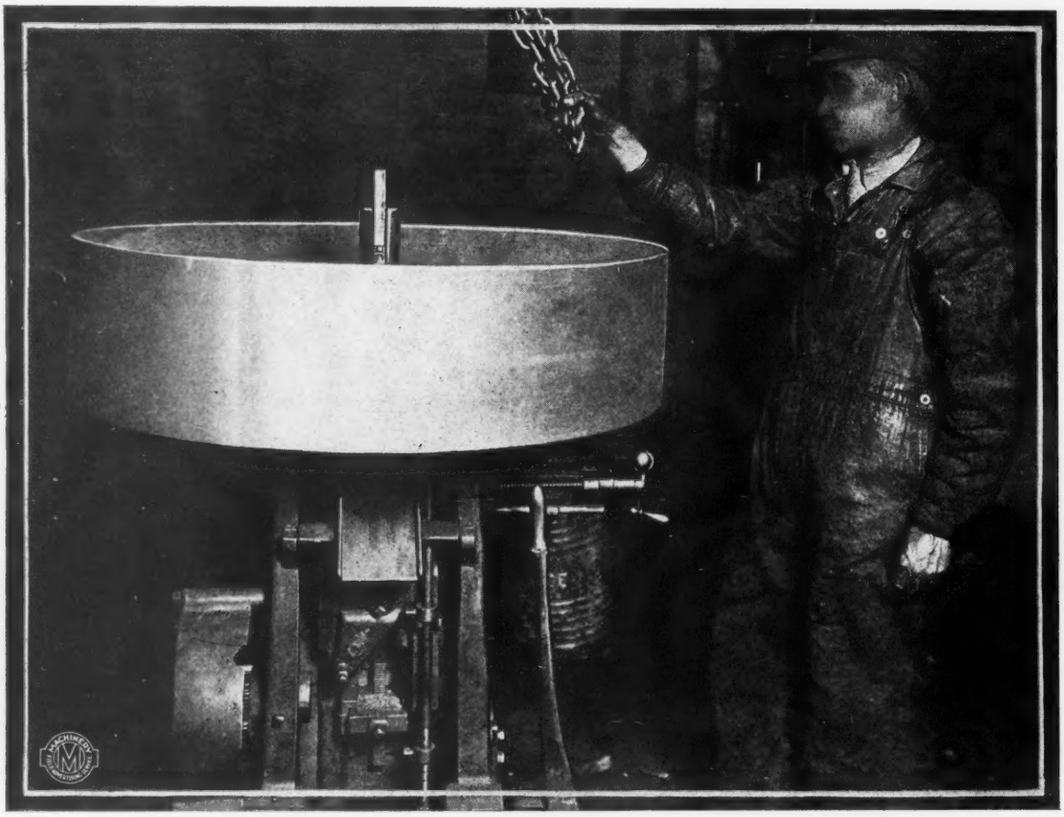
CHINE CO.

Rochester, N. Y.

Write for the Betts Catalog today.



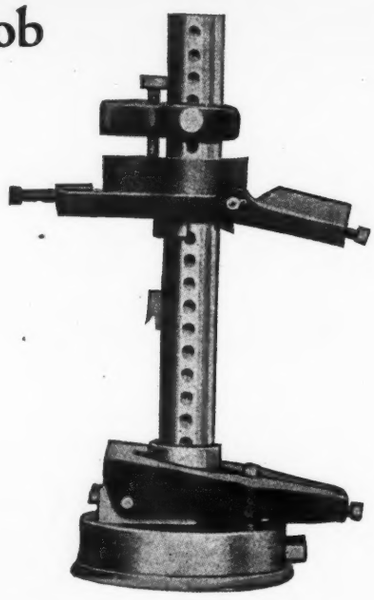
"GIANT" KEYSEATER



Five Minutes Completes This Job

There are not so many places where there's more keyseating to be done than at the great works of the Frick Manufacturing Company, Waynesboro, Pa.; there are few plants where the keyseating is more varied. So, despite the speedy work of **"GIANT"** Keyseaters, every one in the place is kept busy.

"GIANT" Keyseaters play important parts in the building of refrigeration machinery, stationary steam engines, portable engines, steam and kerosene tractors, saw mills, threshing machines, etc. The photograph shows the cutting of a standard keyway ¾" x ⅜", 6" long, through the hub of a cast-iron belt wheel—just a five-minute job for the **"GIANT"**

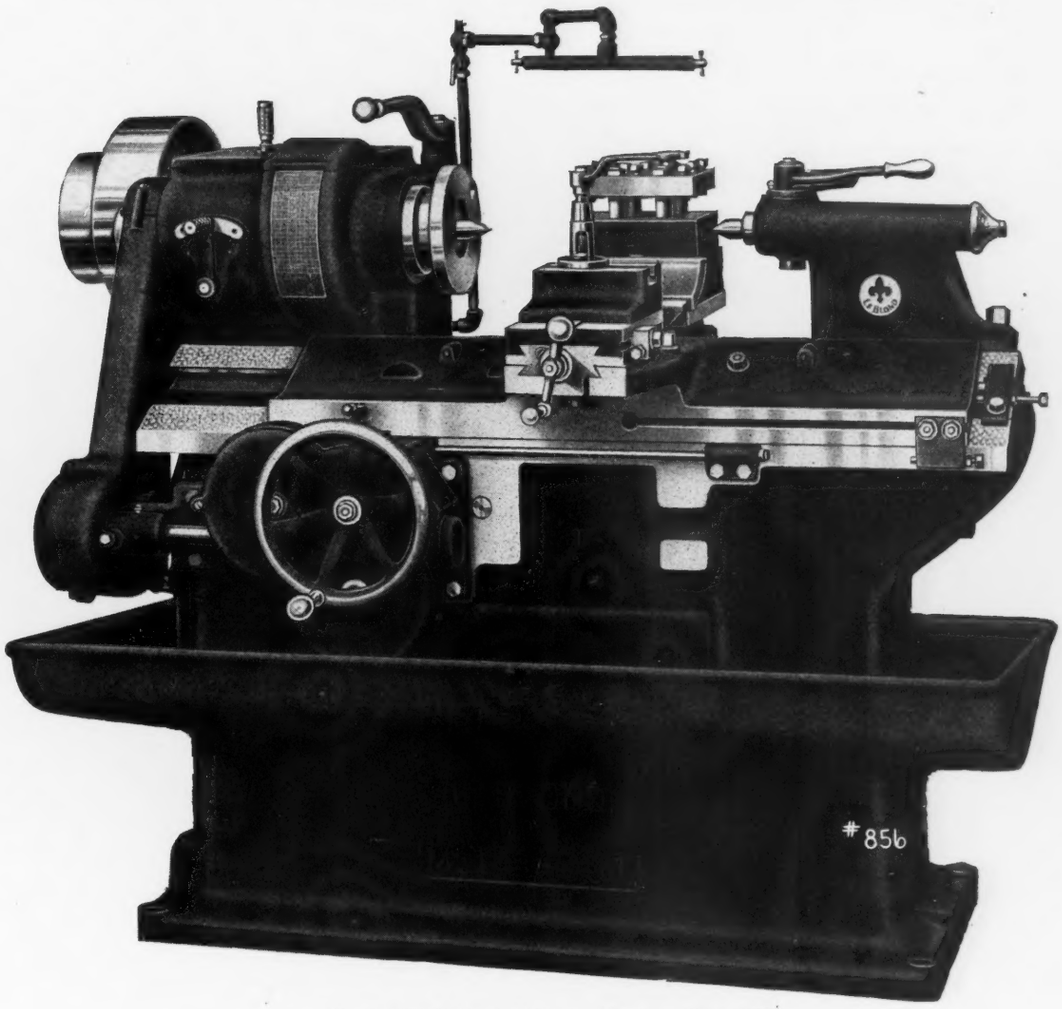


Write for Descriptive Catalog

MITTS & MERRILL, 843 Water Street SAGINAW, MICH.

FOREIGN AGENTS: Burton, Griffiths & Co., London, England. Aux Forges de Vulcain, Lyons and Paris, France. E. Isbecque & Co., Antwerp, Belgium. Nielsen & Winther, Copenhagen, Denmark, Russia, Finland, Siberia, Argentina. V. Lowener, Christiania, Norway and Stockholm, Sweden.

The Multi-Cut Does Not Displace Men It Increases Their Productivity



No. 9 Multi-Cut Lathe — Capacity 9" x 16"

The Multi-Cut releases men for other useful operations and increases the operator's earning power in a direct ratio to the extent that the multiple tool idea is applicable to your job.

The work may be centered, chucked or held on arbors. Flanges, gears, pistons, hubs and transmission shafts, on which as many as 10 tools can be cutting simultaneously, furnish the field for the Multi-Cut.

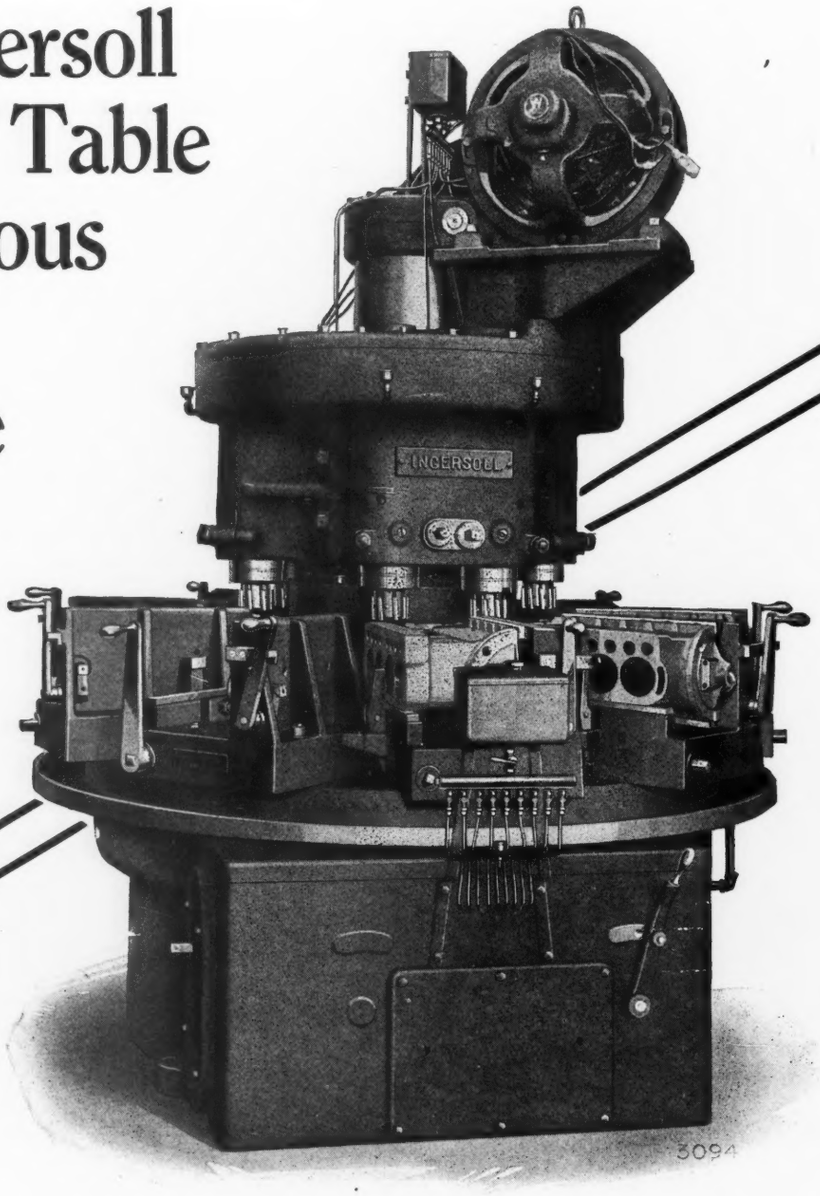
The turning and facing tools complete their work at the same time and trip to close limit of accuracy.

Capitalize the possibilities of Multi-Cutting in your shop.

The R.K.Le Blond Machine Tool Co.

Cincinnati.Ohio.

The Ingersoll Circular Table Continuous Milling Machine



THE Ingersoll Circular Table Continuous Milling Machine is a multiple-spindle, multi-station milling machine on which all the spindles are *continuously* engaged in the work. The number of spindles and stations may be varied to suit the particular work in hand.

In the machine shown above, there are three stations. Each station has two spindles, one for the roughing cutter and the other for the finishing cutter. The table carries nine fixtures, each holding a cylinder casting while the starter pad is milled. The table revolves continuously beneath the spindles. The services of three men are required to unload and reload the fixtures on this tool.

This type of Continuous Milling Machine may also be made for two or four stations, depending on the work to be performed. We would like the opportunity of submitting layout sketches and time estimate of the possibilities your work offers on Ingersoll Milling Machines.

Bulletin No. 37—"Ingersoll Face Milling Cutter Grinder."
Bulletin No. 38—"Ingersoll Milling Cutters."
Bulletin No. 39—"Ingersoll Continuous Milling Machines."

The Ingersoll Milling Machine Co.

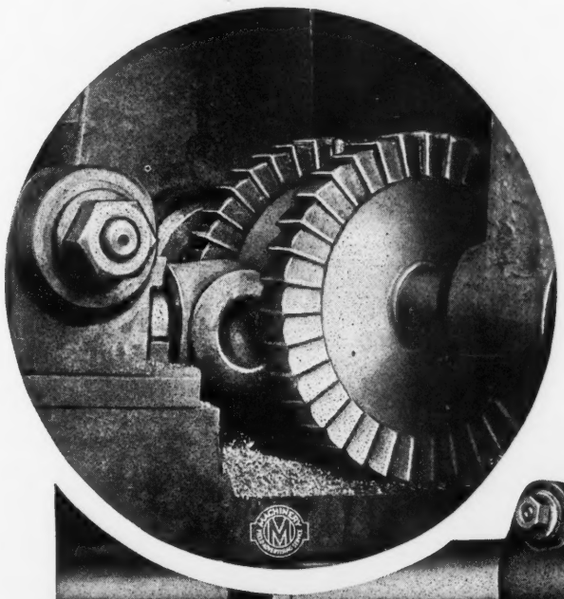
Milling Machines and Their Equipment

Main Office and Works:
Rockford, Ill., U. S. A.

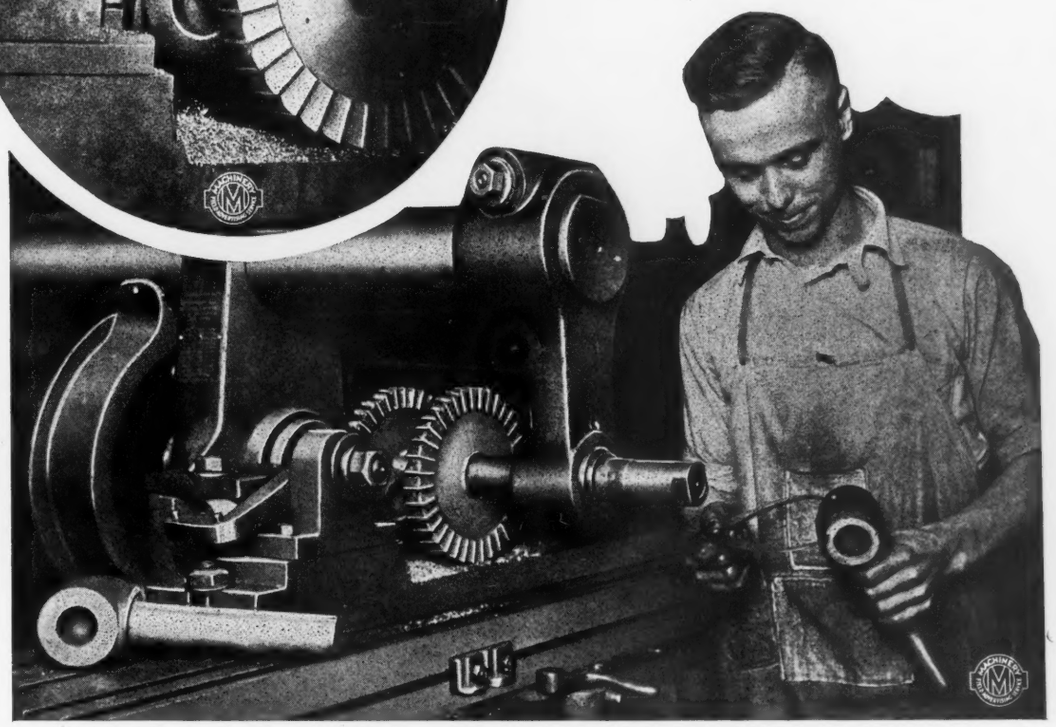
NEW YORK, 50 Church Street
DETROIT, 1457 David Whitney Bldg.
LONDON, Burton, Griffiths & Co., Ltd.
PARIS, Fenwick Freres & Company

KEMPSMITH MILLERS

Used in the Production of La Crosse Tractors



Here we are again—Kempsmith Millers on another nationally known product. This time it's La Crosse tractors. Four Kempsmith Millers are kept busy in this plant; two universal milling machines for precision tool work, etc., two plain milling machines for production. One of the latter is shown straddle milling drop forged steel steering knuckles. About $\frac{1}{8}$" is removed from milled surfaces, and production is very good—twenty per hour. Write for the latest Kempsmith catalog.



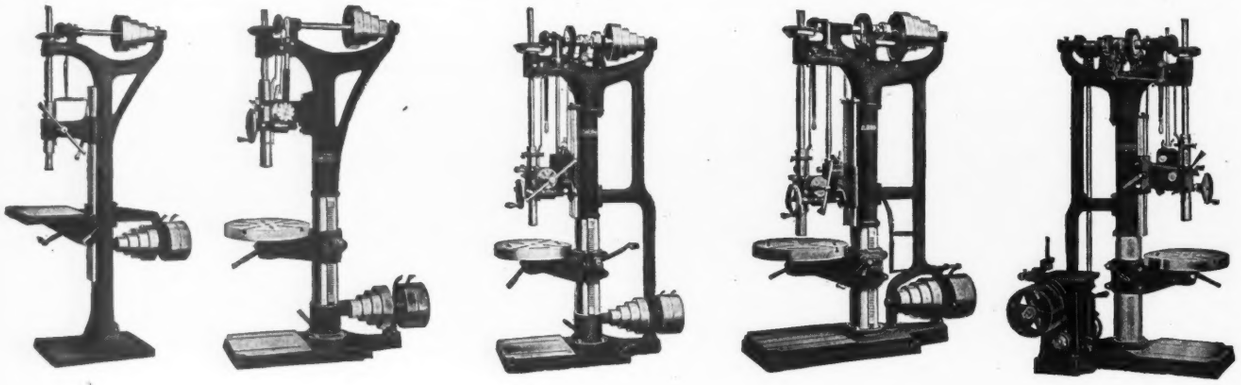
KEMPSMITH MILWAUKEE, U.S.A.

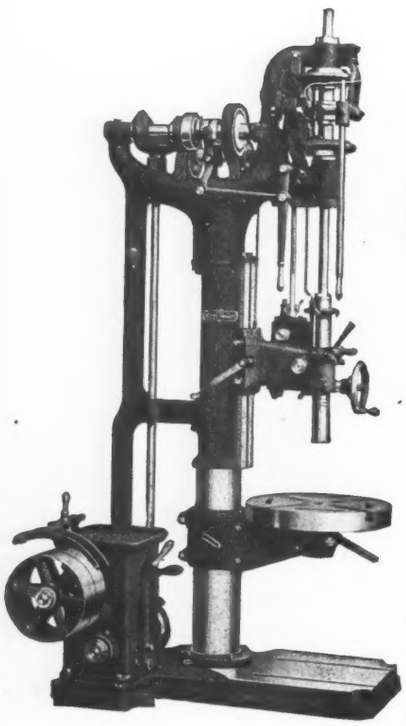
DOMESTIC AGENTS

Biggs Watterson Co., 1235 West 9th St., Cleveland, Ohio. Brownell Machinery Co., 11 Eddy St., Providence, R. I. Cadillac Tool Co., 268 Jefferson Ave., Detroit, Mich. Carolina Supply Co., Greenville, S. C. Eccles & Smith, 46 Front St., Portland, Ore. E. L. Essley Mchy. Co., 555 Washington Blvd., Chicago, Ill., 222 Grand Ave., Milwaukee, Wis. Fairbanks Co., Cor. Light and Lombard St., Baltimore, Md., 325 Colorado Bldg., Washington, D. C., 636 Builders Exchange, Minneapolis, Minn. National Supply Co., Toledo, Ohio. Osborne & Sexton Mchy. Co., Columbus, Ohio. Salt Lake Hardware Co., Salt Lake City, Utah. Smith-Booth-Usher, 228 Central Ave., Los Angeles, Cal. Smith Courtney Co., Richmond, Va. H. A. Smith Mchy. Co., 501 E. Water St., Syracuse, N. Y. Somers, Fitler & Todd, 329 Water St., Pittsburgh, Pa. Homer Strong, 301 State St., Rochester, N. Y., Ellicott Sq. Bldg., Buffalo, N. Y. Taylor Mchy. Co., 78 Batterymarch St., Boston, Mass. Thomson Tool & Supply Co., Odd Fellows Bldg., Indianapolis, Ind. Vandyck Churchill Co., Singer Bldg., Liberty St., New York, N. Y., 734 Widener Bldg., Philadelphia, Pa., 808 First National Bank Bldg., New Haven, Conn. Fred Ward & Son, 171 First St., San Fancisco, Cal. Fulton Supply Co., Atlanta, Ga. The Fairbanks Co., 115 S. 11th St., St. Louis, Mo. P. H. McArdle, 713 Carondelet St., New Orleans, La.

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THE CINCINNATI

A 24- to 42-Inch High Speed Upright Drilling Machine Arranged for Speed Box Drive

One of the many practical styles which adapt this well-built line of machines to modern drilling needs and make the name "Cincinnati" synonymous with complete drilling service the length and breadth of the land.

We were pioneers in the drilling machine industry 46 years ago, and we are leaders today, aiming always to excel in our particular line and catering exclusively to that discriminating class of machine-tool users which looks for practical serviceability and durable efficiency in selecting its equipment.

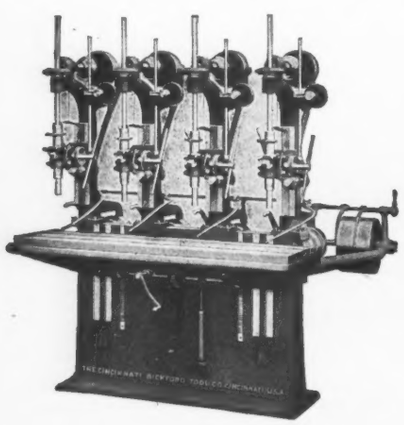
The Cincinnati Bickford Tool Co.

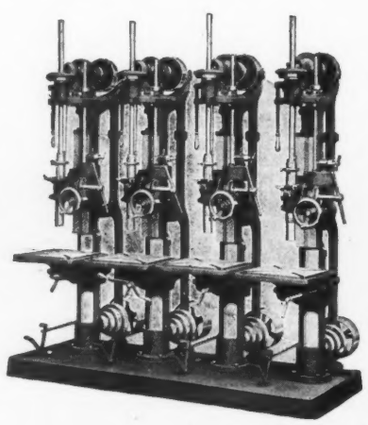
Oakley, Cincinnati, Ohio, U. S. A.

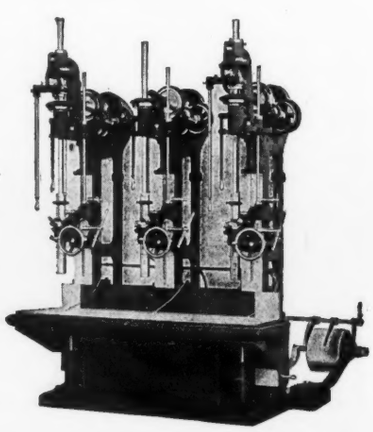
Founded 1874

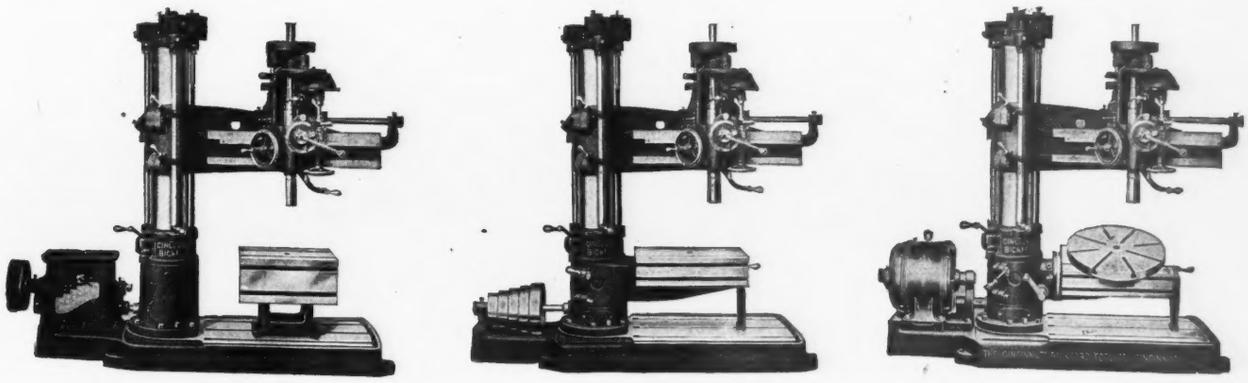
U569

DOMESTIC AGENTS: Henry Prentiss & Co., Inc., New York, Hartford, Conn.; Boston, Mass.; Buffalo, Rochester, and Syracuse, N. Y. **Motch & Merryweather Machinery Co.**, Cleveland, Ohio; Detroit, Mich.; Cincinnati, Ohio, and Columbus, Ohio. **Marshall & Huschart Machinery Co.**, Chicago, Ill. **Brown & Zortman Machinery Co.**, Pittsburgh, Pa. **W. E. Shipley Machinery Co.**, Philadelphia, Pa. **Marshall & Huschart Machinery Co. of Indiana**, Indianapolis, Ind. **Elliott & Stephens Machinery Co.**, St. Louis, Mo. **Harron, Rickard & McCone**, San Francisco, Calif., and Los Angeles, Calif. **C. T. Patterson Co., Ltd.**, New Orleans, La. **Robinson, Cary & Sands Co.**, St. Paul, Minn., and Duluth, Minn. **Kemp Machinery Co.**, Baltimore, Md. **Dewstoe Machine Tool Co.**, Birmingham, Ala. **Seeger Machine Tool Co.**, Atlanta, Ga. **Halildie Machinery Co.**, Seattle, Wash.







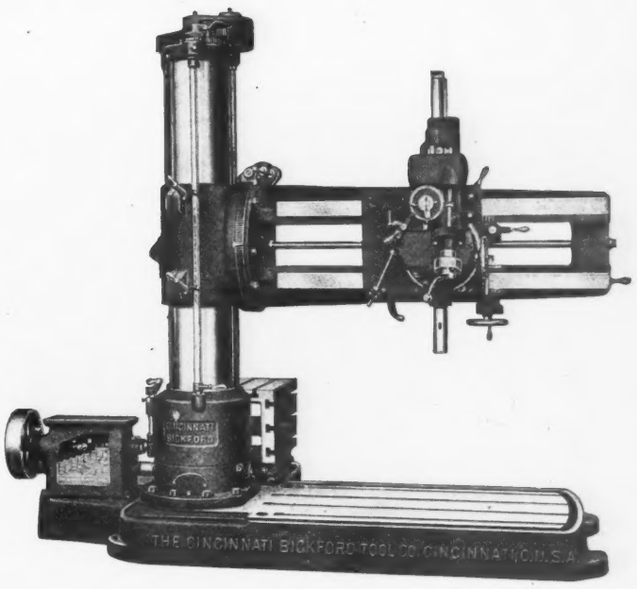


THE CINCINNATI BICKFORD

A Universal Radial Drilling Machine with 4-, 5- and 6-Foot Arm

In designing the machine here shown, we have conclusively demonstrated that universality in a drilling machine does not necessitate any less power, rigidity and durability. The machine here shown has the same double-column construction as our plain heavy duty models, the same general proportions and relative distribution of parts, and its distinctive Patented Arm offers the same resistance to spring as our less elaborately equipped mechanism.

This arm consists of two complete tubes with an opening between them. It is liberally equipped with ball bearings and readily swings, elevates or rotates to any desired angle.



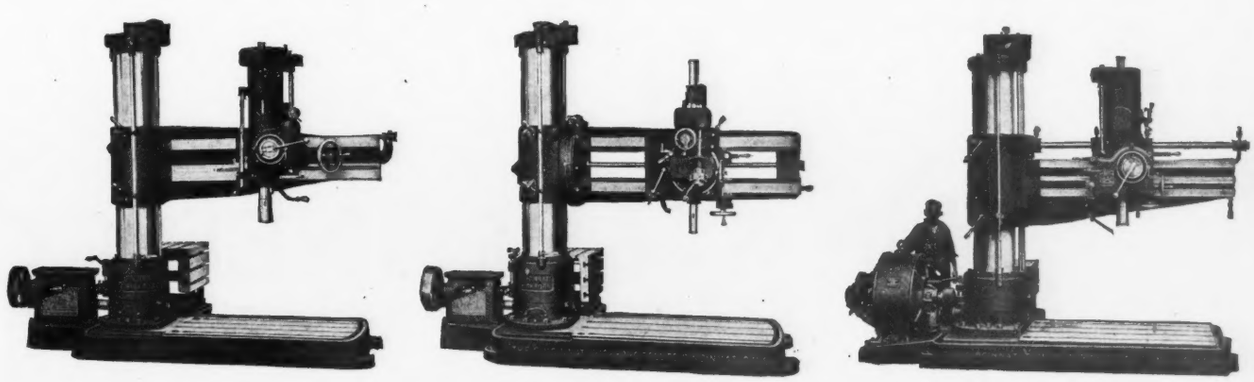
The Cincinnati Bickford Tool Co.

Oakley, Cincinnati, Ohio, U. S. A.

Founded 1874

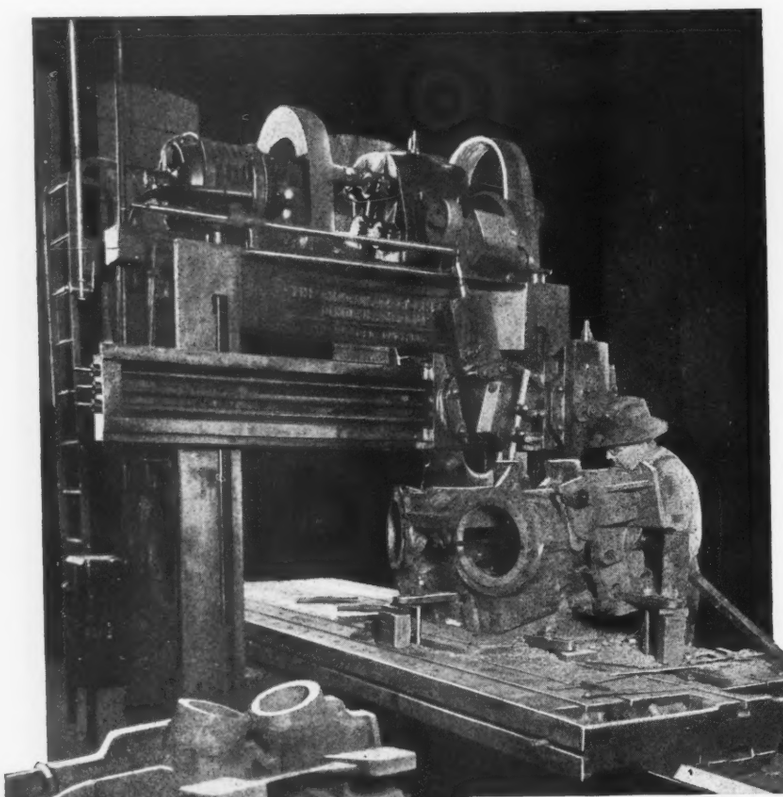
R569

Zimmerman-Wells-Brown Co., Portland, Ore. **Charlotte Supply Co.,** Charlotte, N. C. **Cochran Machine Tool Co.,** Memphis, Tenn. **CANADIAN AGENTS: H. W. Petrie, Ltd.,** Toronto, Ont. **Williams & Wilson, Ltd.,** Montreal and Quebec. **FOREIGN AGENTS: Charles Churchill & Co., Ltd.,** London, Manchester, Birmingham, Newcastle-on-Tyne, England, and Glasgow, Scotland. **Aux Forges de Vulcain,** Paris, France. **Hijo de Miguel Mateu,** Barcelona, Spain. **Ateliers Demoor St. Ame,** Brussels, Belgium. **Chr. A. Herstad,** Copenhagen, Denmark and Stockholm, Sweden. **Andrews & George Co.,** Tokyo, Japan. **McPherson's Pty., Ltd.,** Melbourne, Australia. **Bartle & Co.,** Johannesburg, South Africa. **H. S. Gray Co.,** Honolulu, Hawaii. **Gustav Nielsen,** Christiania, Norway. **Maskin-Aktiebolaget E. Gronblom,** Abo, Finland.



CINCI

Variable Speed Planers



Just Think!

The first of four Cincinnati Planers in the shops of the Locomotive Stoker Co., Pittsburgh, Pa., installed 10 years ago, is planing 1200 lb. Rack Housings, removing $\frac{3}{8}$" of metal at one cut with 40 limits .002 plus or minus; the time floor to floor is three hours. Certainly! It has variable cutting speeds.

Today They Have

Greater facilities for greater hourly production, such as rapid power traverse, to make them handy and responsive.

Forced Lubrication to Vees to prevent scoring, simplify up-keep and maintain accuracy. Box Table for rigidity and convenience.

Box Arch for rugged strength and stability.

Automatic Stop for Elevating Device for safety.

Each one emphasizes production despite the shorter day.

Our "Treatise on Planers"

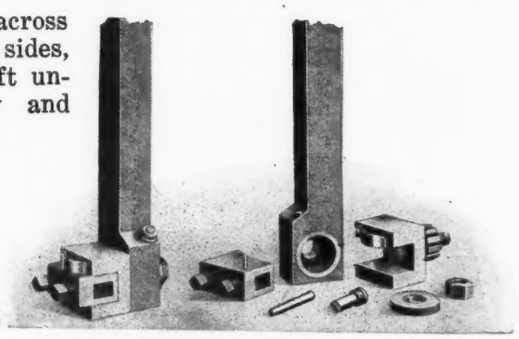
(Price 50 cts.) will show you many "kinks" in Planer practice that can be used to advantage.

Send for our circulars.

Whalen Patent Combination Tool Holders

Cut in any position, across flat surfaces, down the sides, and do right and left undercutting efficiently and economically.

Especially valuable for planing Lathe Beds, undercutting vees or wherever a side head cannot be used.

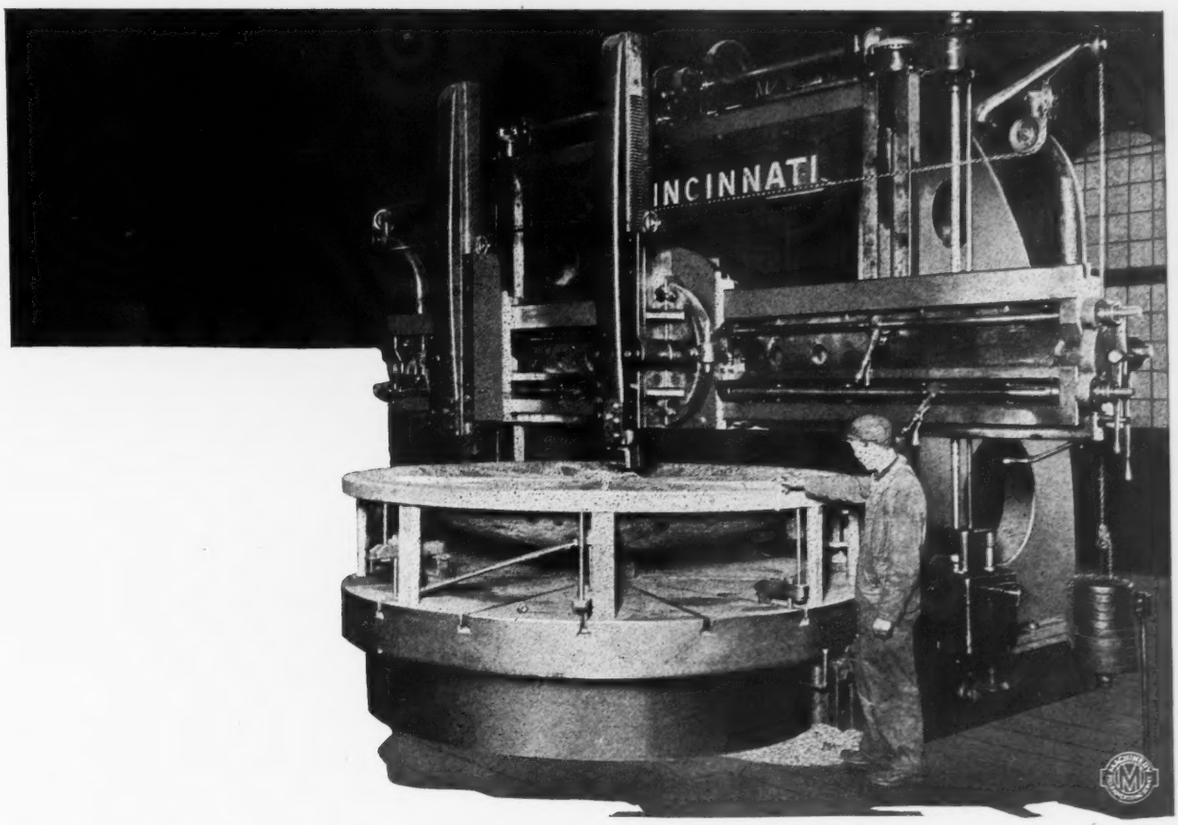


CINCINNATI PLANER CO.

DOMESTIC AGENTS: Henry Prentiss & Co., Inc., New York City, N. Y.; Boston, Mass., Buffalo, N. Y., Syracuse, N. Y., Rochester, N. Y. Motch & Merryweather Machinery Co., Cleveland, O., Detroit, Mich., Pittsburgh, Pa., Cincinnati, O. Marshall & Huschart Machinery Co., Chicago, Ill., Indianapolis, Ind. W. E. Shipley Mchy. Co., Philadelphia, Pa. Kemp Machinery Co., Baltimore, Md. Seeger Machine Tool Co., Atlanta, Ga. C. T. Patterson Co., New Orleans, La. Eccles & Smith Co., San Francisco, Cal., Los Angeles, Cal. Zimmerman, Wells & Brown Co., Portland, Oregon. Hallidie Mchy. Co., Seattle, Wash. Hendrie & Blothoff Mfg. & Supply Co., Denver, Colo. Union Iron Works, Spokane Wash. Salt Lake City Hardware Co., Salt Lake City, Utah. Henry Prentiss & Co., Inc., Hartford, Conn. Elliott & Stephens Mchy. Co., St. Louis, Mo.

NNATI

Rapid Production Boring Mills



"First-Class Machines — No Doubt About It"

Says the Foreman of this Plant

This Cincinnati Boring Mill has been in use in the Shops of the Western Gas Construction Co., (Fort Wayne, Ind.) for about a year and the foreman talks of it with all the enthusiasm a shop man feels for a big machine that "makes good."

A year's use has given opportunity for all kinds of working tests—the piece shown is a digestor head to go into a large ink factory —and the satisfaction freely expressed will last as long as this machine is in use.

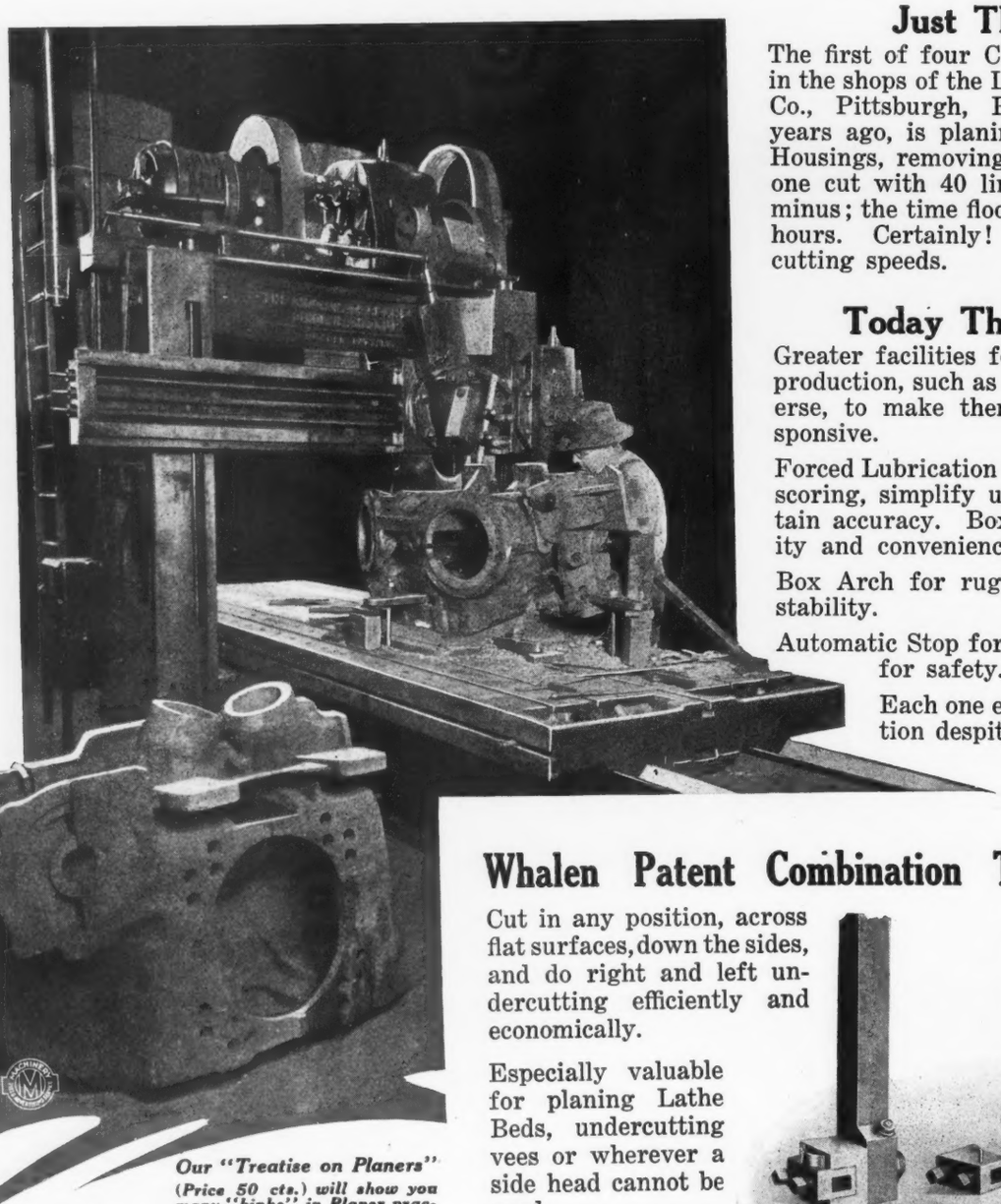
Do you know these big machines? Have you seen them in operation? If not, write us for details; we will tell you where you can find one in your neighborhood.

Cincinnati, Ohio, U. S. A.

CANADIAN AGENTS: Rudel-Belnap Mchy. Co., Toronto, Ont., Montreal, Que. FOREIGN AGENTS: Aux Forges de Vulcain, Paris, France. C. Churchill & Co., London, England, (Planers). Geo. H. Alexander Mchy. Ltd., Birmingham, England, (Boring Mills). Ing. Ercole Vaghi, Milano, Italy. J. Lambercier & Co., Geneva, Switzerland. Chr. A. Herstad, Copenhagen, Demark, Stockholm, Sweden. Gustav Nielsen, A/S, Christiania, Norway. C. Schinz, Petrograd, Russia. Maskin-Aktiebolaget, E. Gronblom, Abo Finland. Ateliers Demoor, Brussels, Belgium. Andrews & George Co., Tokyo, Japan. Benson Bros., Sydney, Australia. H. S. Gray Co., Honolulu. Hijo De Miguel Mateu, Barcelona, Spain.

CINCIN

Variable Speed Planers



Just Think!

The first of four Cincinnati Planers in the shops of the Locomotive Stoker Co., Pittsburgh, Pa., installed 10 years ago, is planing 1200 lb. Rack Housings, removing 3/8" of metal at one cut with 40 limits .002 plus or minus; the time floor to floor is three hours. Certainly! It has variable cutting speeds.

Today They Have

Greater facilities for greater hourly production, such as rapid power traverse, to make them handy and responsive.

Forced Lubrication to Vees to prevent scoring, simplify up-keep and maintain accuracy. Box Table for rigidity and convenience.

Box Arch for rugged strength and stability.

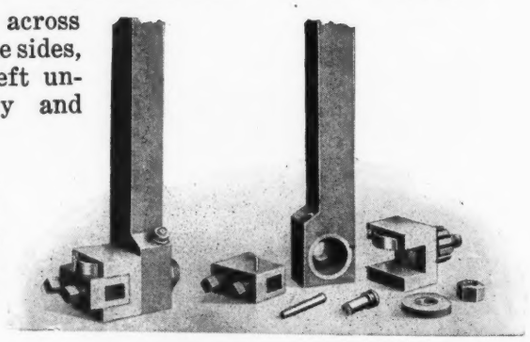
Automatic Stop for Elevating Device for safety.

Each one emphasizes production despite the shorter day.

Whalen Patent Combination Tool Holders

Cut in any position, across flat surfaces, down the sides, and do right and left undercutting efficiently and economically.

Especially valuable for planing Lathe Beds, undercutting vees or wherever a side head cannot be used.



Our "Treatise on Planers"

(Price 50 cts.) will show you many "kinks" in Planer practice that can be used to advantage.

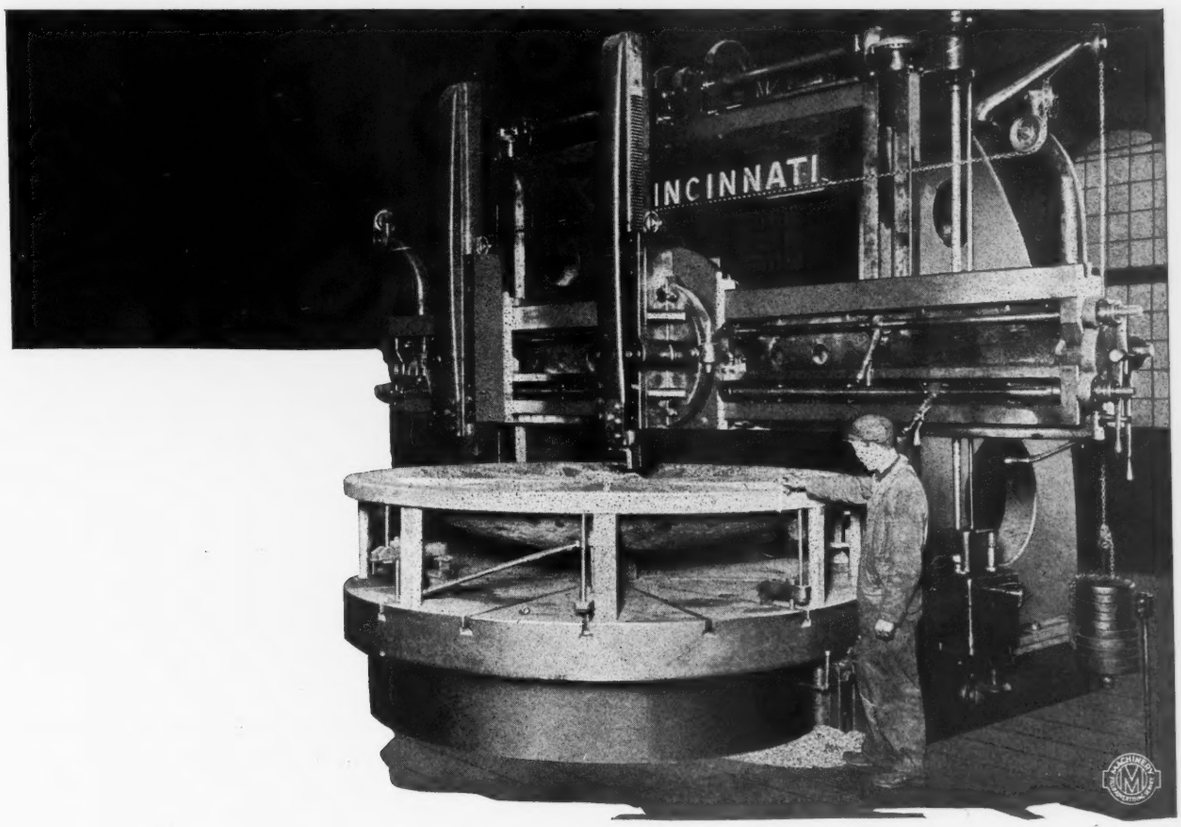
Send for our circulars.

CINCINNATI PLANER CO.

DOMESTIC AGENTS: Henry Prentiss & Co., Inc., New York City, N. Y.; Boston, Mass., Buffalo, N. Y., Syracuse, N. Y., Rochester, N. Y. Motch & Merryweather Machinery Co., Cleveland, O., Detroit, Mich., Pittsburgh, Pa., Cincinnati, O. Marshall & Huschart Machinery Co., Chicago, Ill., Indianapolis, Ind. W. E. Shipley Mchy. Co., Philadelphia, Pa. Kemp Machinery Co., Baltimore, Md. Seeger Machine Tool Co., Atlanta, Ga. C. T. Patterson Co., New Orleans, La. Eccles & Smith Co., San Francisco, Cal., Los Angeles, Cal. Zimmerman, Wells & Brown Co., Portland, Oregon. Hallidie Mchy. Co., Seattle, Wash. Hendrie & Blothoff Mfg. & Supply Co., Denver, Colo. Union Iron Works, Spokane Wash. Salt Lake City Hardware Co., Salt Lake City, Utah. Henry Prentiss & Co., Inc., Hartford, Conn. Elliott & Stephens Mchy. Co., St. Louis, Mo.

INNATI

Rapid Production Boring Mills



"First-Class Machines — No Doubt About It"

Says the Foreman of this Plant

This Cincinnati Boring Mill has been in use in the Shops of the Western Gas Construction Co., (Fort Wayne, Ind.) for about a year and the foreman talks of it with all the enthusiasm a shop man feels for a big machine that "makes good."

A year's use has given opportunity for all kinds of working tests—the piece shown is a digestor head to go into a large ink factory —and the satisfaction freely expressed will last as long as this machine is in use.

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Get Cincinnati-Acme Figures

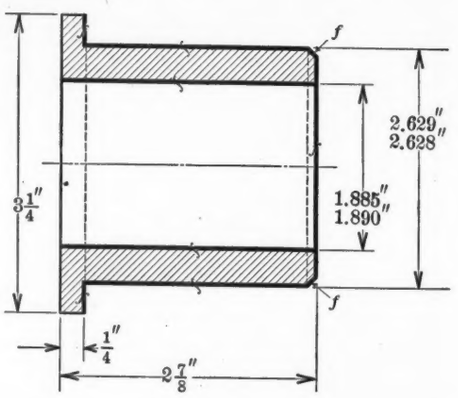
On Your Work—*It's Results That Count*



BUYING a turret lathe is a great deal like buying a motor car—both are merely a means to getting a certain kind of service; but how you get it and how much it costs, are things that are too often found out after the purchase has been completed. A better plan is to study the *work* of the machine you have in mind—study the machine in the hands of another owner, rather than in the shops of the maker.

That's the way we want you to figure on Cincinnati-Acme Lathes, for after all, it's results that count—*and they count most.*

The accompanying picture shows a Cincinnati-Acme Flat Turret Lathe in the La Crosse Tractor plant (La Crosse, Wisconsin), machining tractor wheel bushings. The operations are as follows: 1, chuck; 2, rough bore; 3, semi-finish bore; 4, ream; 5, rough turn outside diameter and rough face under side of flange; 6, finish turn outside diameter and finish face under side of flange. Production is 12 per hour, or five minutes each.



THE ACME MACHINE TOOL COMPANY

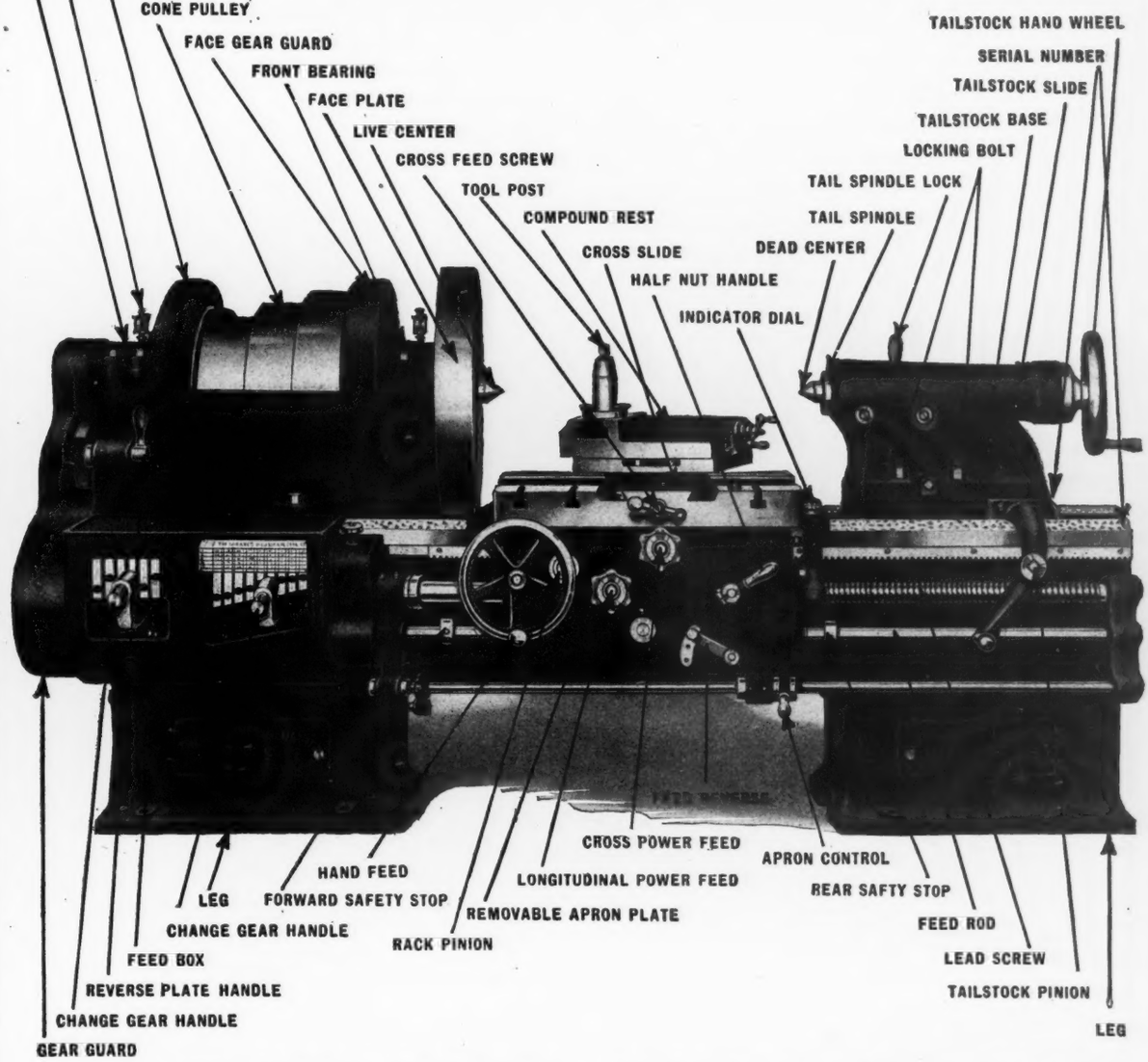
CINCINNATI, OHIO, U. S. A.

Flat Turret Lathes **Screw Machines** **Turret Lathes**

DOMESTIC AGENTS: Henry Prentiss & Co., Inc., New York City, Boston, Mass., Buffalo, N. Y., Syracuse, N. Y., Rochester, N. Y.; Motch & Merryweather Mchy. Co., Cleveland, O., Detroit, Mich., Pittsburgh, Pa., Cincinnati, O.; Marshall & Huschart Mchy. Co., Chicago, Ill., Indianapolis, Ind.; Elliott & Stephens Mchy. Co., St. Louis, Mo.; W. E. Shipley Mchy. Co., Philadelphia, Pa.; Kemp Mchy. Co., Baltimore, Md.; Seeger Machine Tool Co., Atlanta, Ga.; C. T. Patterson Co., New Orleans, La.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; Dewstoe Machine Tool Co., Birmingham, Ala.; Eccles & Smith, Seattle, Wash., Los Angeles, Cal., San Francisco, Cal., and Portland, Ore. Robinson, Cary & Sands Co., St. Paul, Minn. FOREIGN AGENTS: Aux Forges de Vulcain, Paris, France; George H. Alexander Mchy., Ltd., Birmingham, England; H. P. Gregory & Co., Sydney, Australia; J. Lambercier & Co., Geneva, Switzerland; Chr A. Herstead, Copenhagen, Denmark, Stockholm, Sweden; Gustav Nielson, A/S, Christiania, Norway; Maskin-Aktiebolaget E. Gronblom, Abo, Finland. E. Isbecque & Co., Brussels, Belgium. Andrews & George Co., Tokyo, Japan. Miguel Mateu & Son, Barcelona, Spain. CANADIAN AGENTS: Rudel-Belnap Machinery Co., Montreal, Toronto.

The Greaves-Klusman Lathe

Covering One Point at a Time



This is the first of a series of advertisements to bring out "one point at a time," the constructural features of the G-K Lathe.

A glance at the above illustration tells its own story. One of the important and big problems in designing a lathe bed is to reduce the twisting and bending strains to a minimum. This has been accomplished in G-K Lathes by heavy ribbing, which extends the full depth of the bed—this is a considerable improvement over ordinary practice.

Another important improvement in G-K Lathes is the Tool Pressure Angle, which is offset between the spindle center and the center line of the bed. This construction prevents the carriage from buckling, the apron from getting out of alignment, and the tool from chattering.

We build a complete line of engine lathes, from 14″ to 30″ inclusive. All sizes are built with quick change mechanism.

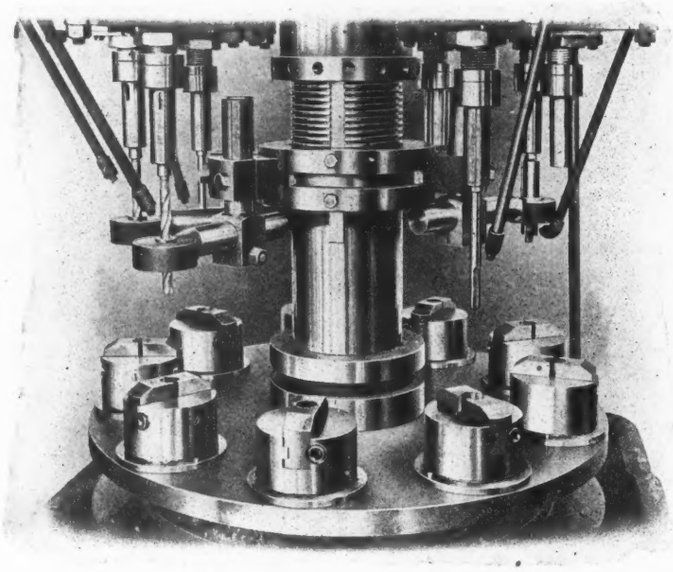
Catalog mailed upon request.

THE GREAVES-KLUSMAN TOOL COMPANY

CINCINNATI OHIO, U. S. A.

AGENTS:

The Fairbanks Co., New York City, Philadelphia, Washington, Baltimore, Albany, Boston, Buffalo, Hartford, Newark, Paterson, New Orleans, Scranton, Syracuse, Trenton, Rochester, Providence, Bridgeport. Federal Machinery Sales Co., Chicago, Ill., and Milwaukee, Wis. J. R. Stone Tool & Supply Co., Detroit, Mich. William K. Stamets, Pittsburgh, Pa., and Cleveland, O. Elliott & Stephens Machinery Co., St. Louis, Mo. Eccles & Smith, Portland, Ore. FOREIGN AGENTS: George H. Alexander Machinery, Ltd., Birmingham, England; Yamatake Co., Tokyo, Japan; Chr. A. Herstad, Copenhagen, Denmark and Stockholm, Sweden; Gustav Nielsen, A/S Christiania, Norway.



Cincinnati-Gridley Automatic Multiple Spindle Drills have proven an
I ndispensable factor in solving drilling problems.
No spring to machine or spindles, as all spindles are supported from a
Center column, the thrust on one side of which is balanced
I n having an equalizing thrust on the opposite side, thus the column receives
No undue strain or spring which may be caused by heavy feeds.
Nos. 1-2-3 Morse Taper, or their equivalents are adaptable to the spindles.
As many spindles can be built into the machine as are practical for the class of work
To be operated on, from 5 to 9 being the average number needed. This feature
I s a decided advantage in drilling pieces which are difficult to handle in any other way.
—
Gang drills cannot be compared with this machine when tests show a
Remarkable saving in floor space, and as much as 300% in productive time.
I t Drills, Reams, Counterbores, and Faces; in reality is a vertical screw machine; but
Differs radically from other drilling machines, inasmuch as the tools can be
Located at a common point, or at different points. Holes can be drilled cutting into
Each other or as far apart as the capacity of the machine permits; thus the handling of
Your large variety of work can be reduced to a minimum.

More work at less cost; as the various operations can be divided into as nearly
Uniform unit as possible, thus equalizing the operations, the
Longest of which governs the time to complete the piece.
There is only one position for loading; the table then moves
I n a clockwise manner; does the required cutting, and lowers from the tools. The
Performance is continuous, and when the table has completed one cycle, and the
Loading position is again reached, the finished piece is removed and a blank inserted.
Every index means a finished part.

Do not worry about your drilling problems, our engineering service department is
Ready to solve them for you.
I n requesting information relative to Drills, it will prove to mutual advantage if you
Let us have blue prints, sketches, or samples of work to be performed.
Lose no time in writing for complete descriptive catalog.

CINCINNATI AUTOMATIC MACHINE CO.

CINCINNATI Manufacturers of OHIO

Automatic Multiple Spindle Drills and Screw Machines

THE GENUINE MORSE DRILLS ENCIRCLE THE GLOBE

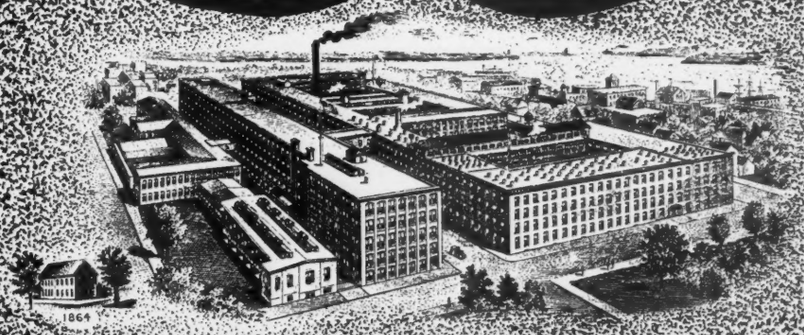
MTD

"Morse" Tools

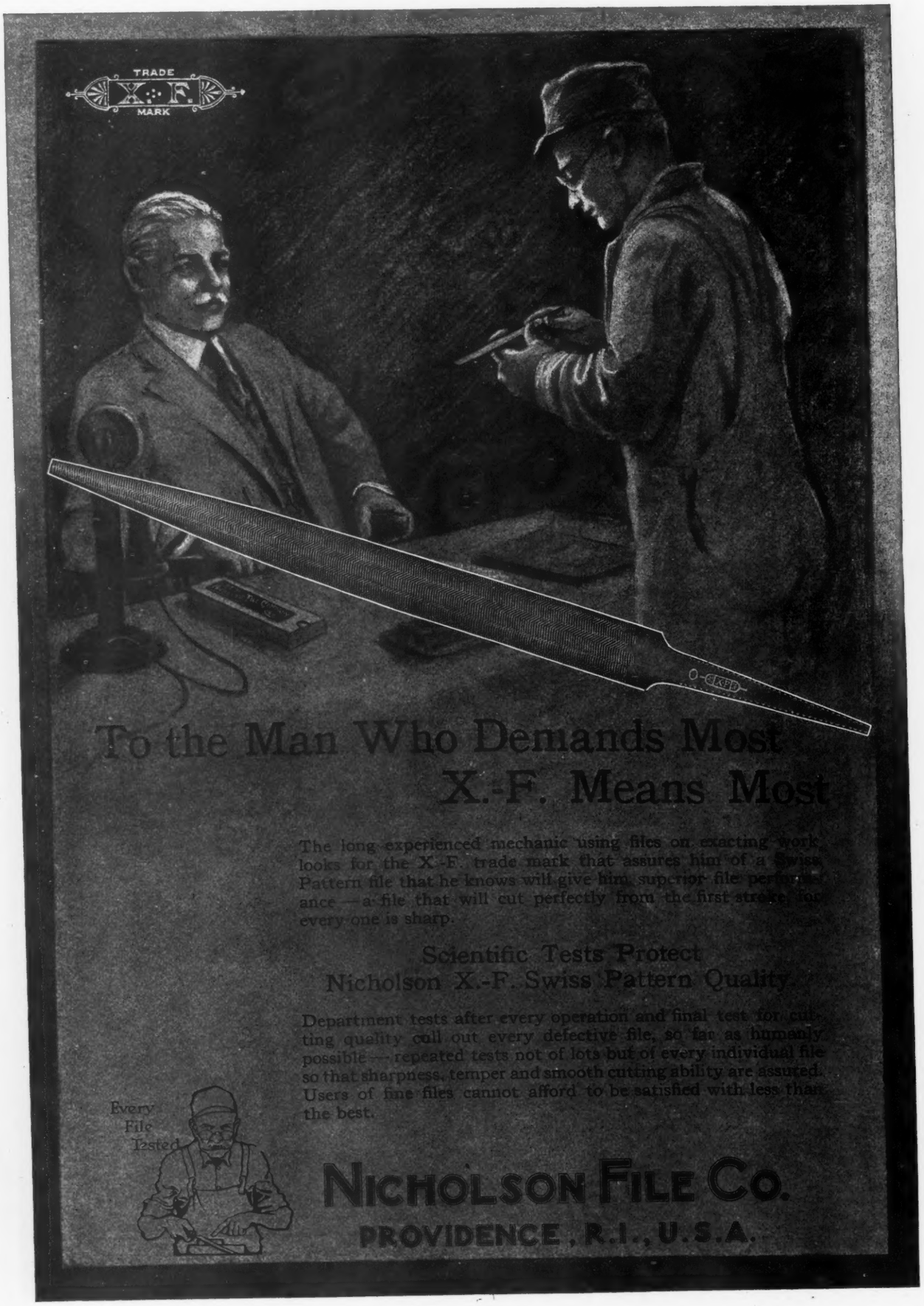
Are proving their worth continually to users all over the world. This is being evidenced by repeat orders which tax our capacity. If it's real service you want, use

"Morse" Tools





Morse Twist Drill & Mch. Co.
New Bedford, Mass. U.S.A.



To the Man Who Demands Most
X.-F. Means Most

The long experienced mechanic using files on exacting work looks for the X.-F. trade mark that assures him of a Swiss Pattern file that he knows will give him superior file performance — a file that will cut perfectly from the first stroke for every one is sharp.

Scientific Tests Protect
Nicholson X.-F. Swiss Pattern Quality

Department tests after every operation and final test for cutting quality cull out every defective file, so far as humanly possible — repeated tests not of lots but of every individual file so that sharpness, temper and smooth cutting ability are assured. Users of fine files cannot afford to be satisfied with less than the best.

Every File Tested

NICHOLSON FILE CO.
PROVIDENCE, R.I., U.S.A.

HAMILTON LATHES



LIKE SEEKS LIKE

A man is judged by the company he keeps, so machines are likely to be judged by the standing of their selling agents and the general class of the machines they carry. Hamilton Lathes are consistently well built, accurate machines, convenient, speedy and economical, popular wherever they are used. Hamilton agents are chosen for their business integrity and their service standards and the quality of the machines they sell.

THE HAMILTON MACHINE TOOL CO.

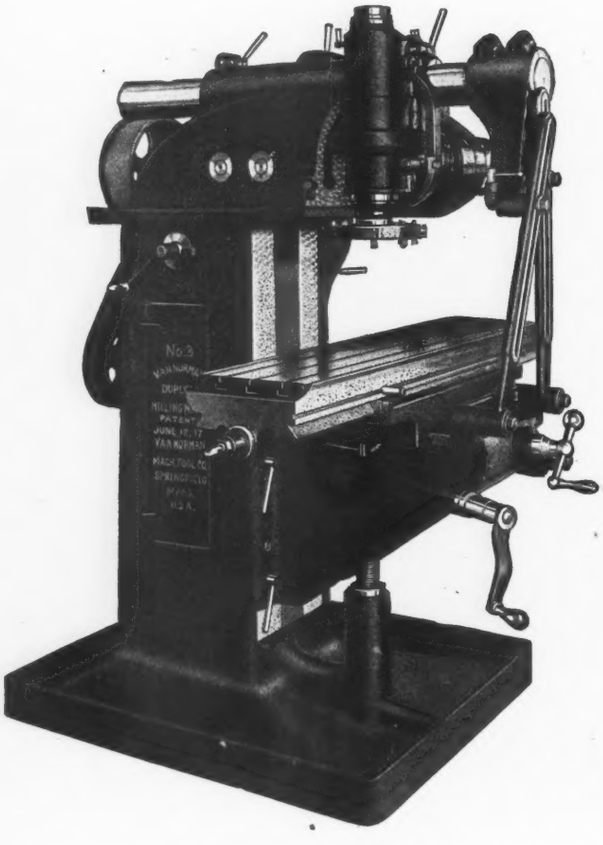
HAMILTON, OHIO, U. S. A.

Read this list of Hamilton Agents; get in touch with the one in your district. Ask him to "show you" our Hamilton Lathes.

DOMESTIC AGENTS: Machineshop Equipment Corp'n., Boston, Mass. Barbour, Love & Woodward, Inc., New York; Syracuse Supply Co., Rochester, N. Y., Syracuse, N. Y., Buffalo, N. Y., Monarch Mchy. Co., Philadelphia, Pa.; The Thompson Machinery Co., Pittsburgh, Pa.; Cooperative Machinery Co., Cleveland, O.; Osborne & Sexton Machinery Co., Columbus, O.; Wolverine Machinery & Supply Co., Detroit, Mich.; Stocker-Rumely-Wachs Co., Chicago, Ill.; Thomson Tool & Supply Co., Indianapolis, Ind.; W. C. Johnson & Sons Mchy. Co., St. Louis, Mo.; F. E. Satterlee Co., Minneapolis, Minn.; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.; Herberts Machinery & Supply Co., San Francisco, Cal., Los Angeles, Cal.; M. J. Walsh Mchy. Co., Milwaukee, Wis.; Textile Mill Supply Co., Charlotte, N. C.; General Fire Extinguisher Co., Atlanta, Ga.; Oliver H. Van Horn, Inc., New Orleans, La. CANADIAN AGENTS: H. W. Petrie, Ltd., Toronto, Ont., Canada.

Rapid Production HAMILTON Machine Tools

VAN NORMAN
DUPLEX MILLER



This is the Van Norman No. 3 Duplex Miller set for vertical milling. Ask us for literature describing the extensive capacity of this machine.

Greatly Extends the Scope of Your Plant at a Small Expenditure of Space.

Rentals are high these days, and getting the most from your floor space means more than it did.

A good beginning is to install the Van Norman No. 3 Duplex Miller. Operating in both horizontal and vertical planes it gives you double efficiency, makes for maximum convenience and a minimum of setting-up time.

The adjustable cutter head, quickly set at any angle, permits the simplest forms of end mills to be used on an unusually large range of work.

The construction is such that in many instances blocking up the work is unnecessary, and a considerable reduction in the cost of fixtures and setting-up time is effected.

VAN NORMAN MACHINE TOOL COMPANY

Office and Factory
160 Wilbraham Ave.
Springfield, Mass., U.S.A.

Branch Sales Offices:
74 Brush Street, Detroit, Mich.
50 Church Street, New York, N. Y.

U. S. Portable Electrically Driven Tools

Soon Pay for Themselves

When Farrell, Kemp & Gushe Company turned its big sheet metal shop at Joliet, Ill., into a war production unit which helped make U. S. Army trucks, the U. S. Portable Electric Drill here shown was installed to drill tractor frames in process of assembling. By the time all Government orders were completed the machine had more than paid for itself.

When the shop went back to making big sheet metal tanks the U. S. Portable Electric Drill stayed right on the job and quickly made a place for itself drilling holes in tank frames of angle iron or steel such as the one shown in the illustration—ten times faster than a man with breast drill. Upkeep is negligible and the machine shows no sign of depreciation, so the company expects a good many years of "velvet."



U. S. Portable Electrically Driven Drills and Grinders are light but durably made, with air-cooled motors, hardened gears and other features which insure long and satisfactory service.

Details in Catalog.

The United States Electrical Tool Co.

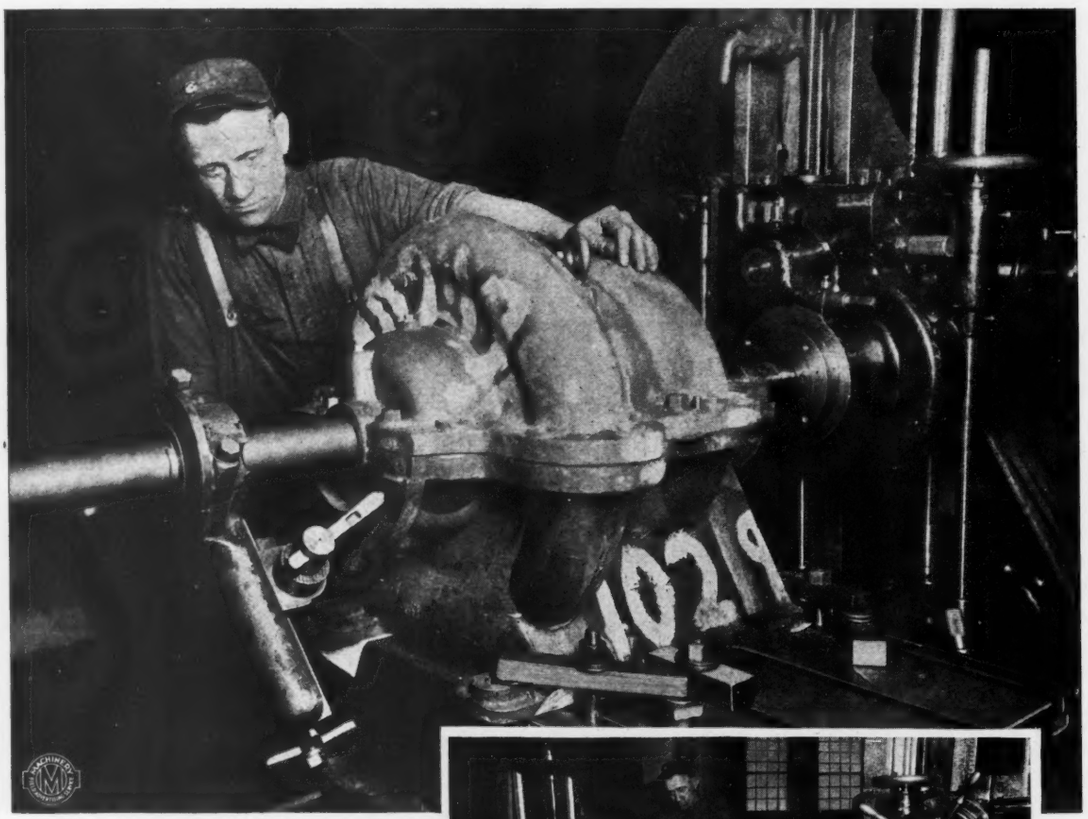
6th Ave. and Mt. Hope St. **CINCINNATI, OHIO, U. S. A.**

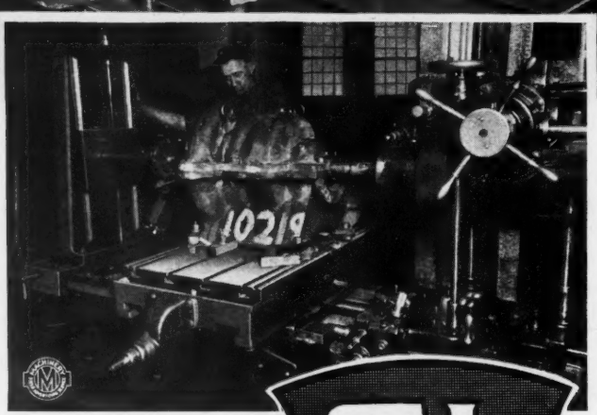
STOCK CARRIED IN BRANCHES

New York Office: 50 Church Street. St. Louis Office: 1956 W. Broadway. Detroit Office: Marquette Bldg. Chicago Office: 549 West Washington Boulevard. Boston Office: 12 Pearl St. Philadelphia Office: The Bourse. Pittsburgh Office: Bessemer Bldg. Cleveland Office: 404 Northern National Bank Bldg.

GIDDINGS & LEWIS

Horizontal Boring, Drilling and Milling Machines





This G & L Performs Many Important Operations on Centrifugal Pump Casings

Boring, recessing and facing centrifugal pump casings is important work, and becomes more important the greater the production. For these operations the Midwest Engine Company installed G & L equipment at its Hill Pump Works, Anderson, Ind., and it meets every need. Photograph shows a No. 32 G & L machining a 4" three-stage casing. There are ten bores, two outside facing operations, eight faces and eight recesses inside, all measurements being held to close limits. Top and bottom casings are clamped together with a gasket between the faces, and a complete pump casing is produced each twenty-four hours.

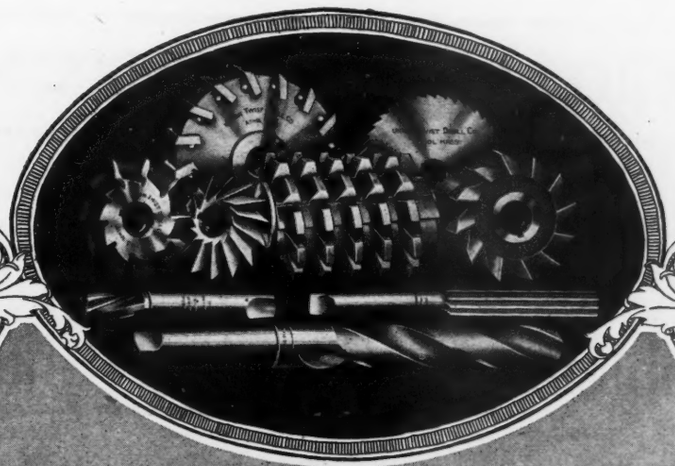
G&L

WRITE FOR CATALOG

Giddings & Lewis Machine Tool Co.

FOND DU LAC WISCONSIN, U. S. A.

DOMESTIC AGENTS: Henry Prentiss & Co., New York City, Syracuse, Rochester, Buffalo, Boston, Hartford; Marshall & Huschart Machinery Co., Chicago, Milwaukee; Swind Machinery Co., Philadelphia, Baltimore; Motch & Merryweather Machinery Company, Cleveland, Pittsburgh, Detroit; E. A. Kinsey Company, Cincinnati, Indianapolis; Smith Courtney Company, Richmond, Va.; Young & Vann Supply Co., Birmingham, Ala.; Blackman-Hill-McKee Machinery Co., St. Louis; Eccles & Smith Co., San Francisco, Los Angeles, Portland; English Tool & Supply Co., Kansas City; Fairbanks Co., New Orleans; McMullen Machinery Co., Grand Rapids, Mich.; Manning, Maxwell & Moore, Inc., Seattle; Northern Machinery Co., Minneapolis; Salt Lake Hardware Co., Salt Lake City; Sunderland Machinery & Supply Co., Omaha. FOREIGN AGENTS: Canadian Fairbanks-Morse Co., Ltd., Toronto, Montreal, Winnipeg, Vancouver, Hamilton; Fenwick Freres & Co., Paris, Lyons, Liege, Brussels, Zurich; Burton, Griffiths & Co., England; R. L. Scrutton & Co., Ltd., Sydney, Australia; Gustav Nielsen, Christiania; A. B. Galco, Ltd., Stockholm, Sweden; Sale & Frazar, Ltd., Tokyo, Japan; American Machinery Syndicate, Spain, Portugal; Maskinbolaget Groenblom, Abo Finland; Gaston, Williams & Wigmore, Shanghai, Honkong, Hankow, Tientsin, China.



Tools of Quality

Time has proved Union Tools. Years devoted to research and experimentation have made them the standard of quality wherever metal cutting is accomplished.

The undercut tooth on High Power Milling Cutters—the accuracy of Union Hobs—these are but natural results where effort is ever directed toward a better product.

Truly—Union Cutters, Drills and Reamers are Tools of Quality.

Union Twist Drill Company

Drill and Cutter Makers

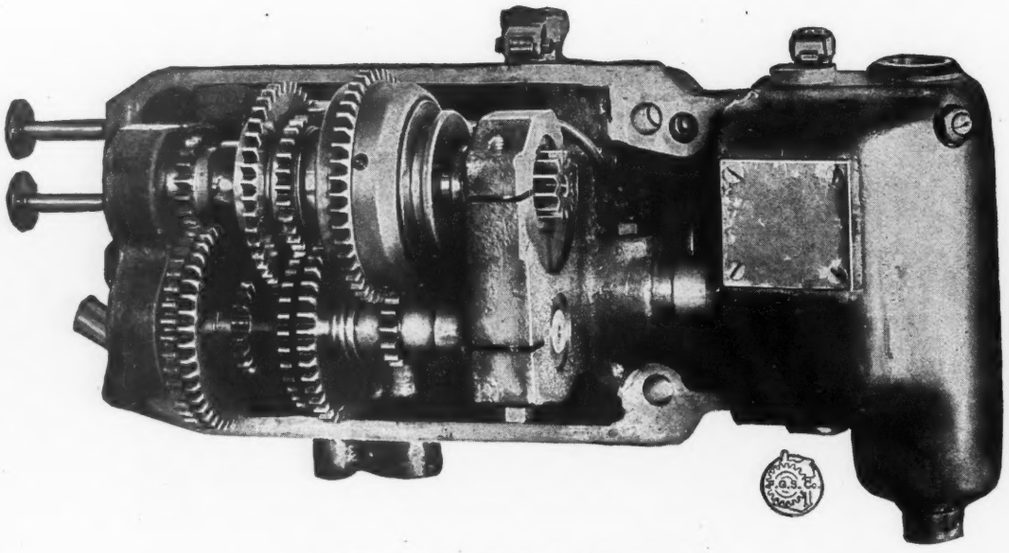
Athol, Massachusetts, U. S. A.

New York Chicago



F.G.S.Co. SERVICE, ACCURACY, PRODUCTION F.G.S.Co.

Solving the Machine Tool Builder's Problems on the Gear Shaper



Feed Box on Cincinnati "M" Type Milling Machine

The feed box of the "M" Type Milling Machine, built by the Cincinnati Milling Machine Co., Cincinnati, Ohio, represents an excellent example of compact gear design. This feed mechanism, it will be noticed, comprises a series of so-called "cluster" or "shoulder" gears grouped close together, and which can be accurately and economically produced if made from one piece.

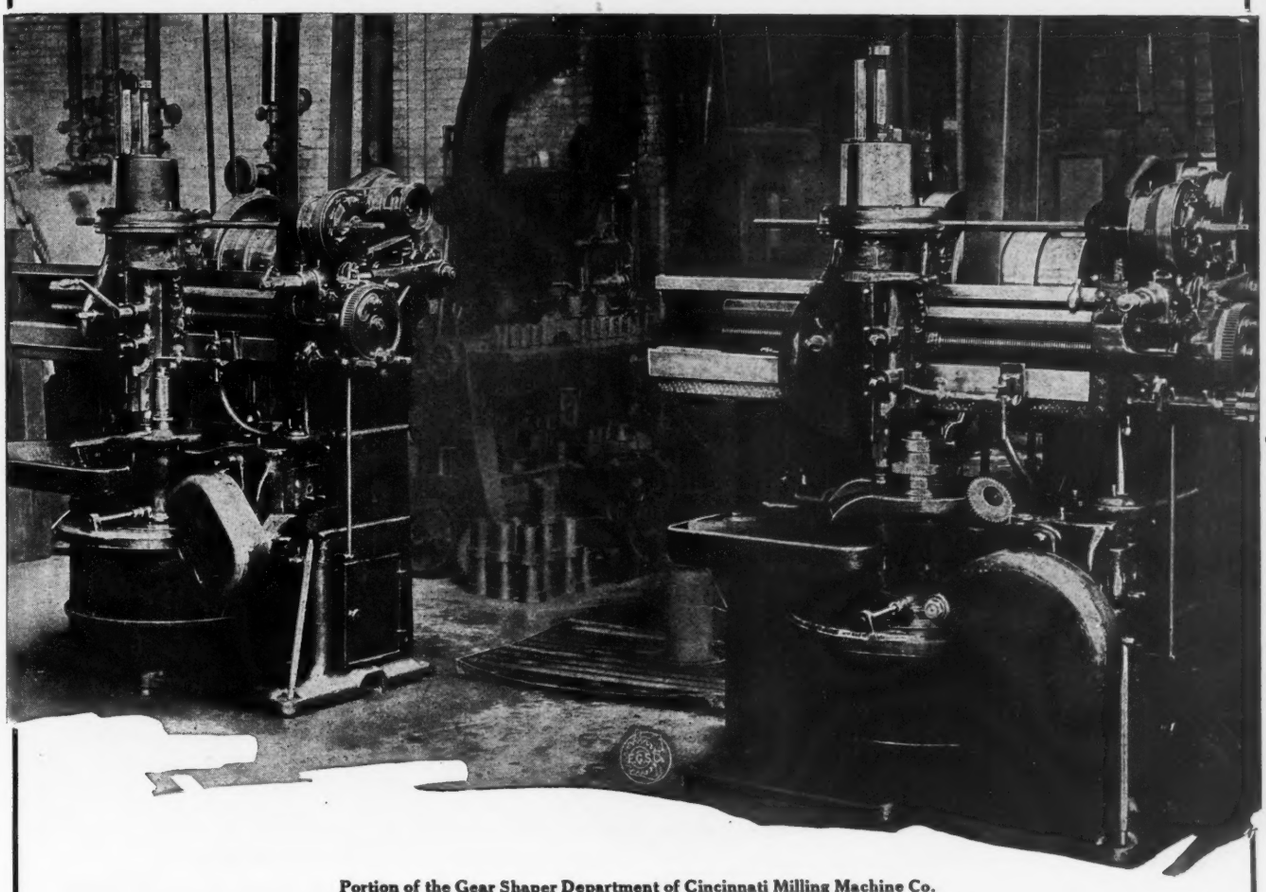
With the Gear Shaper the making of gears from one piece having a clearance groove as little as ⅛ inch between the teeth is easily possible, so that the designer is not confronted with the problem of making his design suit manufacturing requirements. In other words, he can design his product to be compact, convenient and accurate, and then produce parts in commercial quantities on the Gear Shaper.

The Gear Shaper has many possibilities that are of particular interest to machine tool builders. It will handle

SERVICE, ACCURACY, PRODUCTION

a wide range of work, and is an accurate and economical producer of gears. Furthermore, it makes possible the use of various gears that could not be economically produced by any other method.

Some of the possibilities of the Gear Shaper are illustrated in our booklet, "Commercial Gear Cutting," a copy of which we will gladly send to those interested.



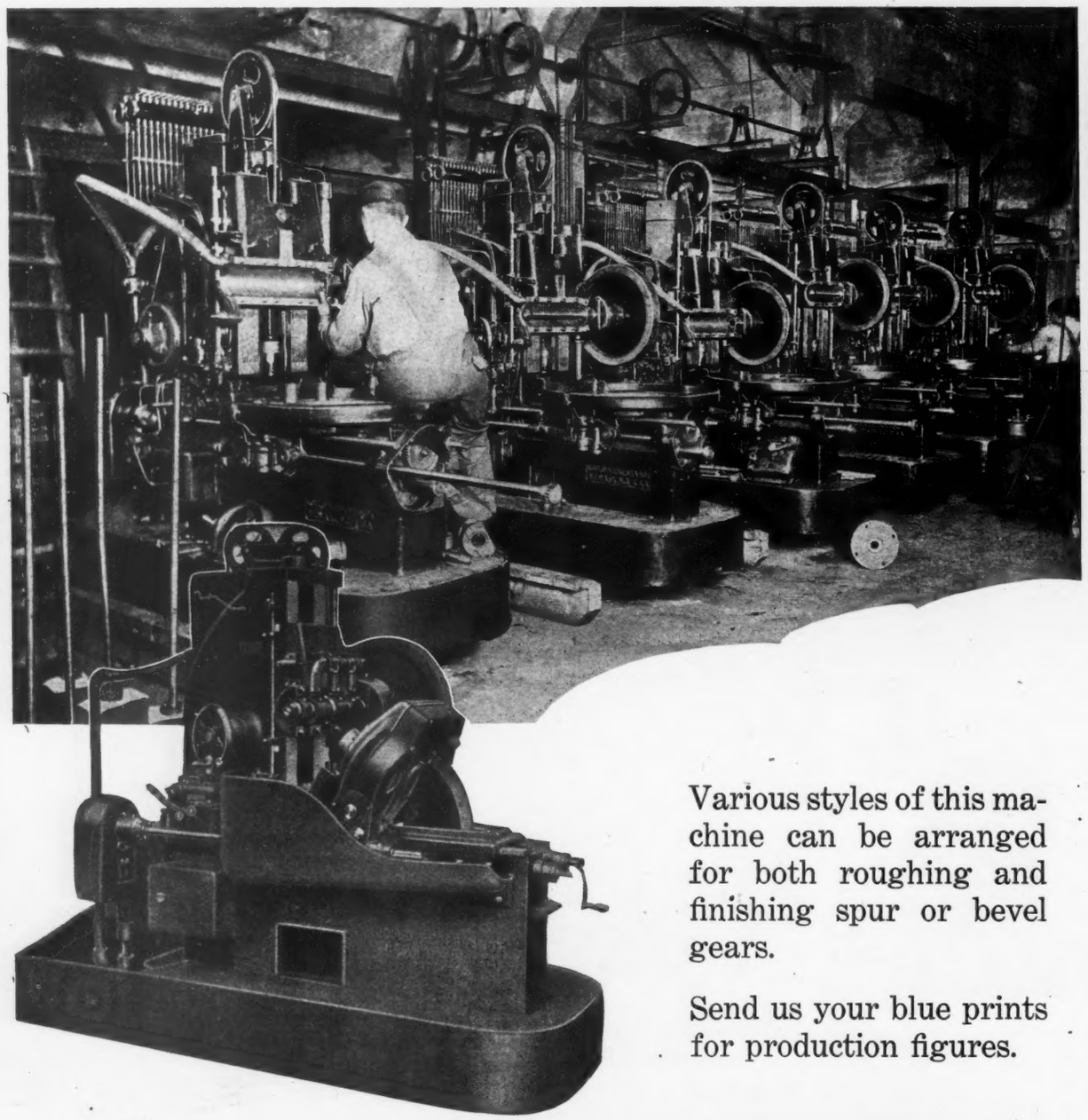
Portion of the Gear Shaper Department of Cincinnati Milling Machine Co.

The Fellows Gear Shaper Company

Springfield, Vermont, U.S.A.

FOREIGN AGENTS: Alfred Herbert, Ltd., Coventry, England; Societe Anonyme Alfred Herbert, Paris, France; Societa Anonima Italiana, Alfred Herbert, Milan, Italy; Alfred Herbert, Ltd., Yokohama, Japan; Societe Anonyme, Alfred Herbert, Barcelona, Spain; Societe Anonyme Belge, Alfred Herbert, Brussels, Belgium; Alfred Herbert (India), Ltd., Calcutta, India.

We Manufacture Gear Cutting Machinery



Various styles of this machine can be arranged for both roughing and finishing spur or bevel gears.

Send us your blue prints for production figures.

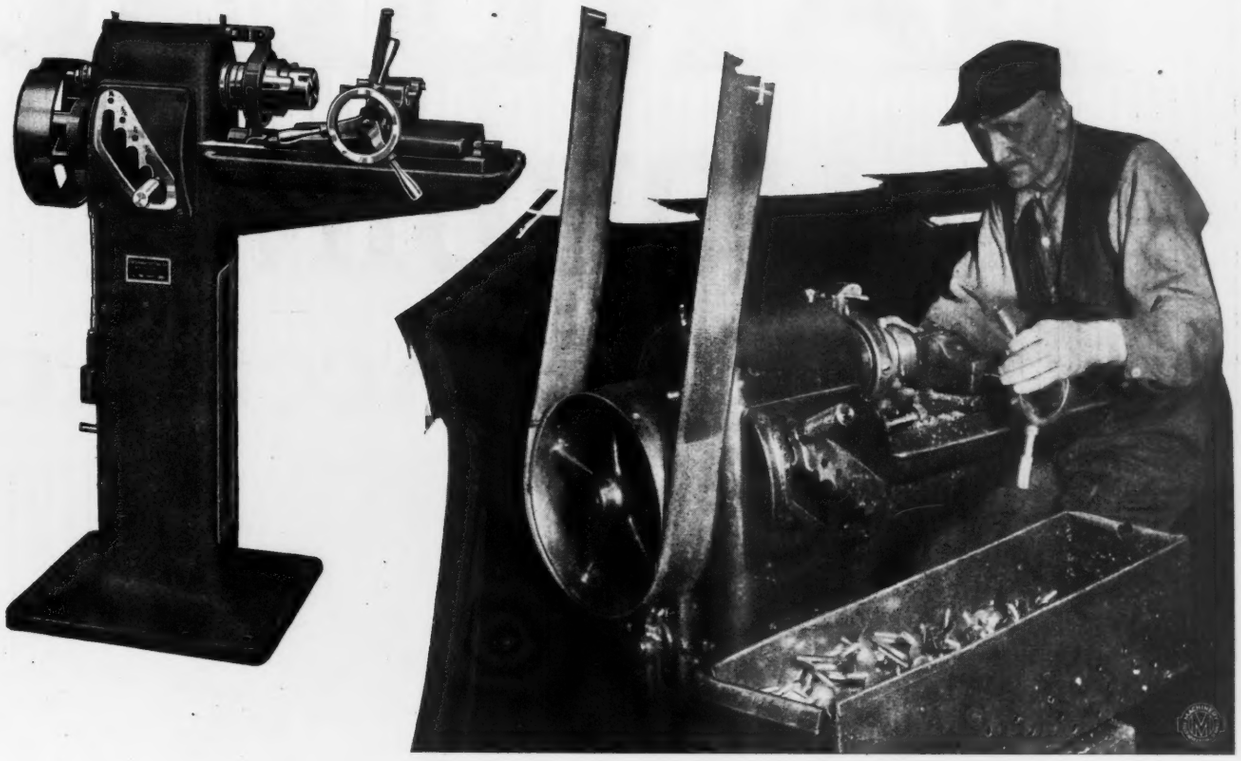
GOULD & EBERHARDT

"HIGH DUTY" SHAPERS
AUTOMATIC GEAR AND RACK CUTTING MACHINERY

ESTABLISHED 1833 NEWARK, N.J. U.S.A.

DOMESTIC AGENTS: Motch & Merryweather Machinery Co., Cleveland, Pittsburgh, Detroit, and Cincinnati; Henry Prentiss & Co., New York, Boston, Buffalo, Syracuse, Rochester, Scranton; Marshall & Huschart Machinery Co., Chicago and Milwaukee; Marshall and Huschart Machinery Co. of Indianapolis, Indianapolis, Ind.; Elliott & Stephens Machinery Co., St. Louis; W. E. Shipley Machinery Co., Philadelphia; Kemp Machinery Co., Baltimore and Richmond; Hallidie Machinery Co., Seattle; Dewstoe Machine Tool Co., Birmingham, Ala.; Seegar Machine Tool Co., Atlanta, Ga.; Robinson, Cary & Sands Co., St. Paul and Duluth, Minn.; Eccles & Smith Co., Los Angeles, San Francisco, and Portland, Ore.; Salt Lake Hardware Co., Salt Lake City, Utah; Oliver H. Van Horn Co., Inc., New Orleans, La. FOREIGN AGENTS: C. W. Burton, Griffiths & Co., London, England; R. S. Stokvis & Zonen, Ltd., Rotterdam; R. S. Stokvis & Fils, S. A., Paris and Brussels; D. Drury & Company, Johannesburg, S. Africa; A. R. Williams Machinery Co., Canada; Horne Co., Ltd., Tokyo, Japan; Victor G. Mendoza, Havana, Cuba; Allied Machinery Co. of America, Switzerland, Italy, China, Spain and Portugal; Chr. A. Herstad, Copenhagen, Denmark; Pedro Martinto, Lima, Peru, South America.

Geometric Threading Machines



One Man—One Machine
Two Thousand Bolts Per Day

A glance at the figures—two thousand bolts per day—conveys the impression of unusually speedy production.

The plant of the Mitchell Motors Company, Inc., Racine, Wis., is as a matter of fact, noted for its careful choice of production units, and the selection of Geometric Threading Machines some five years ago was merely to help carry out this speed-plus-quality policy.

These body bolts are 5/16" diameter, have threads running 18 to the inch, the threaded portion being 1⅛" long. Production averages 200 per hour, or, as previously stated, 2000 per ten-hour day.



Ask for the full line of Geometric literature.

THE GEOMETRIC TOOL COMPANY

NEW HAVEN — **CHICAGO OFFICE 627 West Washington Boulevard** — **CONNECTICUT**

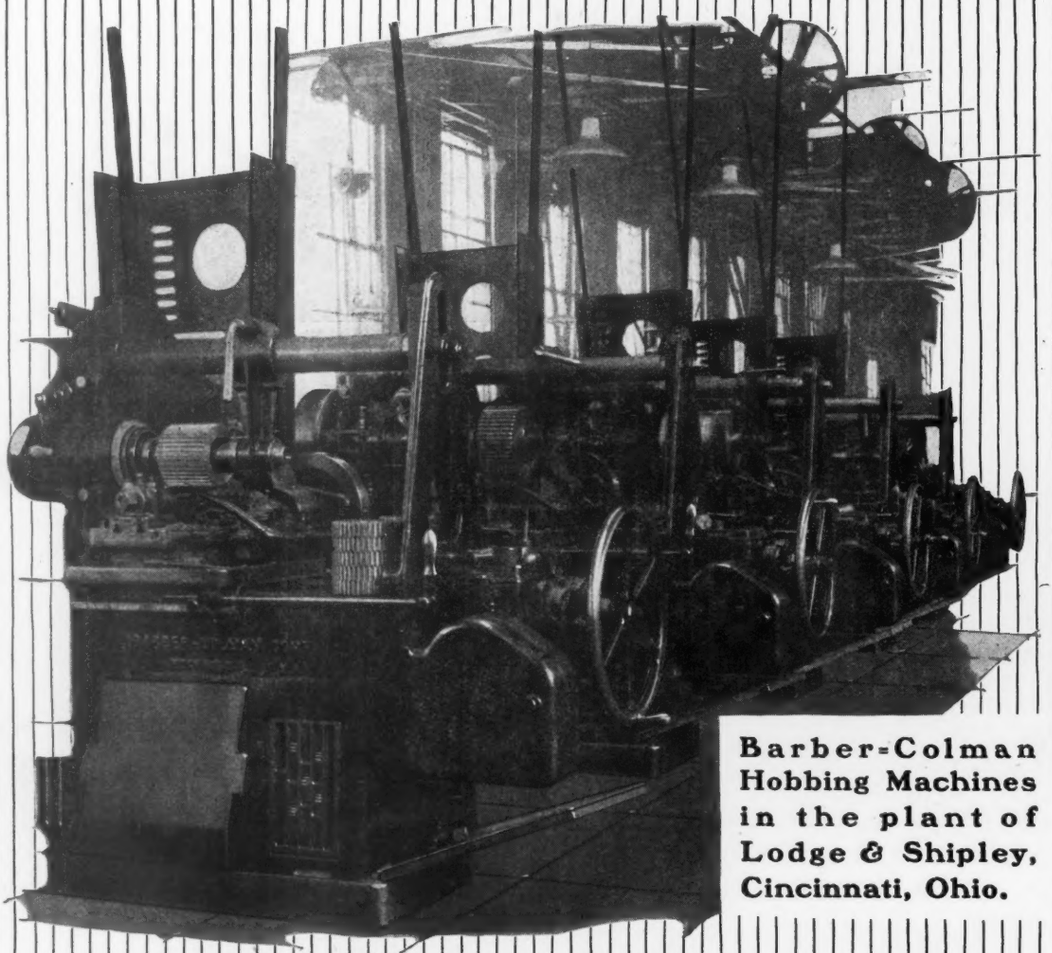
General Distributors for Michigan, The Chas. A. Strelinger Co., Detroit.

WESTERN SALES AGENTS: Blackman-Hill-McKee Mchy. Co., St. Louis, Mo.; Hill, Clarke & Co., Inc., Boston; Kemp Machinery Co., Baltimore, Md.; The National Supply Co., Toledo, Ohio; The W. M. Pattison Supply Co., Cleveland, Ohio; Root, Neal & Co., Buffalo, N. Y.; F. E. Satterlee Co., Minneapolis, Minn.; Somers Filter & Tool Co., Pittsburgh, Pa.; The Tool Equipment Co., San Francisco; Vandyck Churchill Co., New York and Philadelphia; Vonnegut Machinery Co., Indianapolis, Ind.; The C. H. Wood Co., Syracuse, N. Y. CANADA: The Canadian Fairbanks-Morse Co., Ltd., Manitoba, Saskatchewan and Alberta; The A. R. Williams Mchy. Co., Ltd., Toronto, Winnipeg and St. John (N.B.); Williams & Wilson, Ltd., Montreal. FOREIGN AGENTS: Allied Mchy. Co. of America, France, Italy, Switzerland, Spain, Portugal; Andrews & George, Tokyo, Japan; Bevan & Edwards, Melbourne; Chas. Churchill & Co., Ltd., London, Birmingham, Manchester, Glasgow; J. Horstman, Paris; E. Isbecque & Co., Brussels, Belgium; V. Lowener, Denmark, Norway, Sweden, Copenhagen, Christiania, Stockholm; R. S. Stokvis & Zonen, Rotterdam, Holland; White & Rae, Sydney.

BARBER-

HOBBING

ACCURATE



Barber-Colman Hobbing Machines in the plant of Lodge & Shipley, Cincinnati, Ohio.

BARBER-COLMAN COMPANY

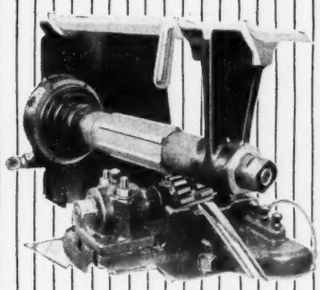
HOME OFFICE & PLANT

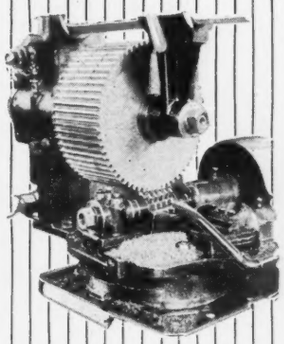
ROCKFORD, ILL., U.S.A.

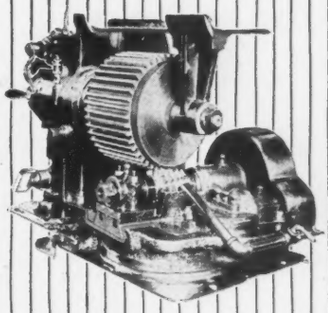
1920-14

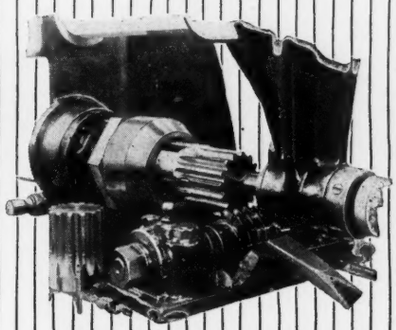
-COLMAN MACHINES

DEPENDABLE

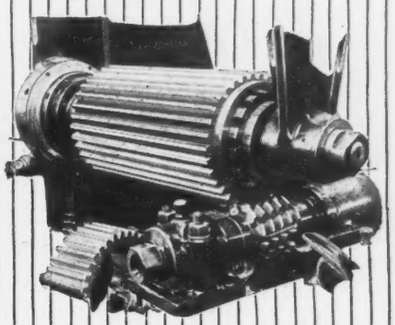








Barber-Colman Hobbing Machines are used in the Lodge & Shipley Plant for cutting gears and spline shafts to be used in Lodge & Shipley machine tools.



BRANCH OFFICES

BOSTON, MASS. BUFFALO, N.Y. CHICAGO, ILL. CLEVELAND, O.
DAYTON, O. DETROIT, MICH. MILWAUKEE, WIS. NEW YORK CITY.

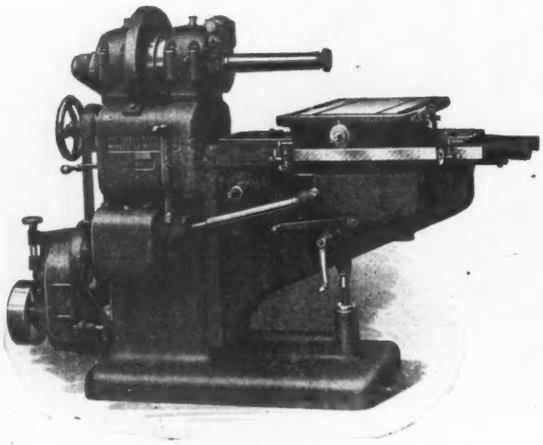
SPAIN
AMERICAN M'CHY SYNDICATE
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BARBER & COLMAN LTD.
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BRUSSELS
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1920-14-A

HEALD



STYLE No. 60 CYLINDER GRINDER

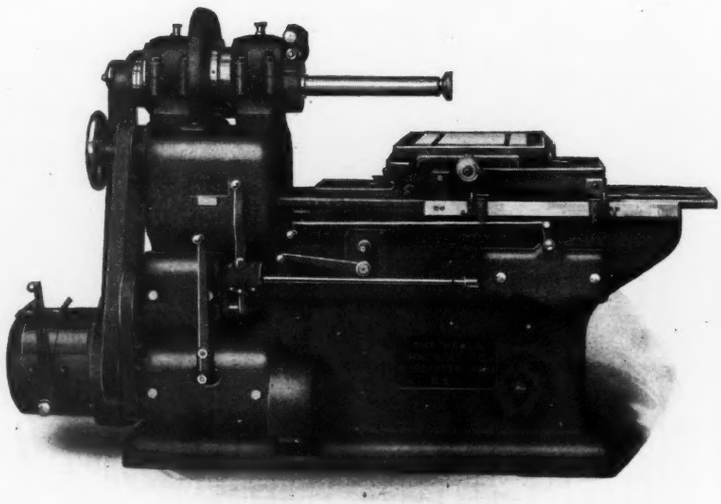
The Heald Cylinder Grinders are especially designed for internal grinding of holes in work of such shape that it is inconvenient or impossible to rotate in the usual manner when machining.

These machines are especially valuable for grinding airplane, marine or automobile engine cylinders. The ordinary method of smooth boring and reaming results in inaccuracies due to hard and soft spots in the casting, as well as springing of the thin cylinder wall. In grinding, the wheel revolves at a high speed in a true circular path, getting hard and soft spots alike, leaving an absolutely round hole.

Railroad shops are now using them to grind bearings in valve motion parts and piston rods, valve rods or brake parts, such as triple valves, etc.

Machine Style No. 60, as shown above, has a large vertical adjustment of 3½ inches, obtained by movement of the knee casting clamped to the bed. This machine is particularly suited to garage work or any shop where a variety of different sized work requires a large vertical adjustment.

Machine No. 65 is our latest style, built for precision and production work. Notice the massiveness, giving rigidity,—centralized control of levers, giving convenience of operation, and that it is self-contained.



STYLE No. 65 CYLINDER GRINDER

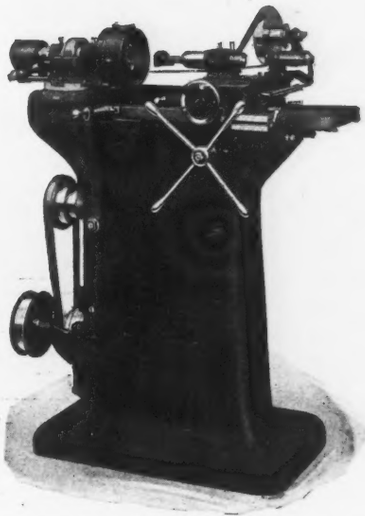
THE HEALD MACHINE CO.

BRANCH OFFICES: New York, 839 Singer Bldg.; Philadelphia, 1308 Commonwealth Bldg.; Chicago, 26 South Jefferson St.; Detroit, 401 Marquette Bldg.; Cincinnati, 311 Provident Bank Bldg.; Cleveland, 721 Engineers' Bldg. WESTERN AGENTS: Eccles & Smith Co., Los Angeles, San Francisco, Seattle and Portland; Salt Lake Hardware Co., Utah and Idaho; Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.

INTERNAL GRINDERS

Heald Internal Grinders are built to handle work which can be easily revolved, such as bushings, cutters, ball races, hardened gears, gauges, cones, etc.

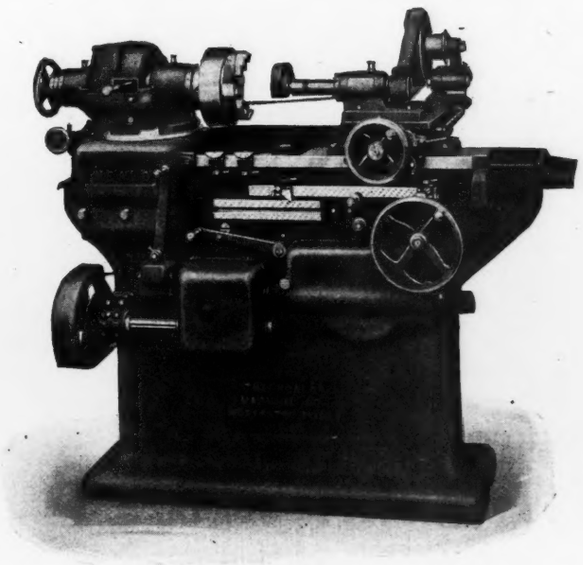
Each wheelhead is made up in a separate unit, instantly interchangeable. Twelve sizes of heads enable these machines to cover a wide range of work, which, together with the swivelling of the workhead, makes this machine indispensable in tool-rooms for grinding straight and tapered holes.



STYLE No. 85 INTERNAL GRINDER

Style No. 85, as shown above, and whose capacity is 10″ swing by 2″ long, was built for small short work. The construction is very simple, and a large number of mechanical features have made it exceptionally well suited for rapid production. It works best on holes smaller than ¾ dia. x 1½ long.

Style No. 70 handles work 15″ dia. x 11″ long. It has both automatic and hand feed for the table. Several new features have been lately added, including friction clutch workhead for starting and stopping the work, longer base to enable the operator to run the wheelhead back when plugging. Also the guard over the wheel has been re-designed so that it entirely covers the wheel.



STYLE No. 70 INTERNAL GRINDER

Let us send you catalogues, together with literature showing these machines working in various factories.

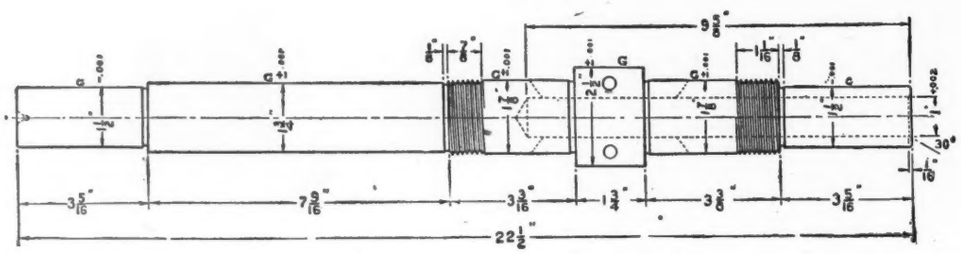
16 New Bond St., Worcester, Mass., U.S.A.

HEALD

FOREIGN AGENTS: Alfred Herbert, Ltd., England; Societe Anonyme, Alfred Herbert, France, Switzerland, and Societa Anonima Italiana, Alfred Herbert; Alfred Herbert, Ltd., Sydney, Australia; Horne Co., Ltd., Japan; Wilh. Sonesson & Co., Sweden, Denmark and Norway; Henri Benedictus, Brussels, Belgium; American Machinery Syndicate, Spain and Portugal.

Foster Production Results

FRICTION CLUTCH SHAFT-A.3.S.



JUST A "FEW COLD FIGURES"

This shaft was machined on the engine lathe in 82 minutes at a total cost, including wages and factory overhead, of $2.22 per piece.

It is now being machined on a Foster 2-B Universal Turret Lathe in 35 minutes at a total cost of 95 cents per piece.

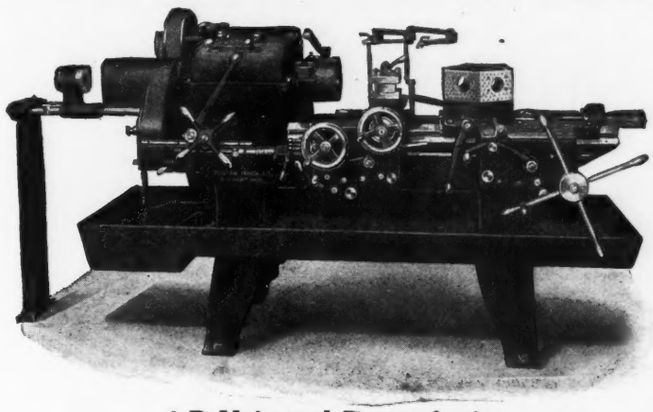
NET SAVING PER PIECE, $1.27

NET SAVING PER DAY'S PRODUCTION, $17.78

Are you interested?
Send us your blue prints for estimate.

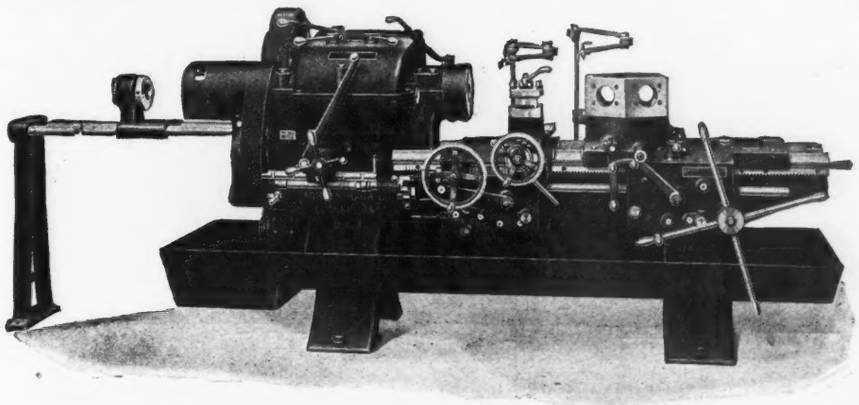
FOSTER MACHINE CO.,

The Foster Universal Turret Lathe

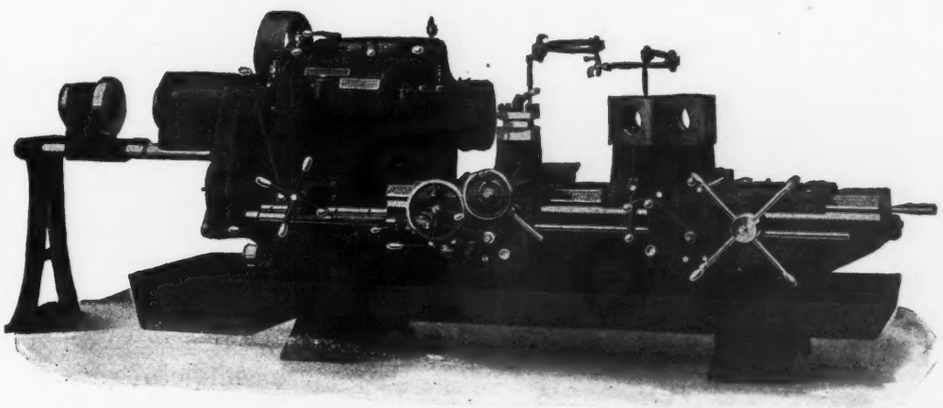


For Bar Work and Chucking Work

1-B Universal Turret Lathe



2-B Universal Turret Lathe



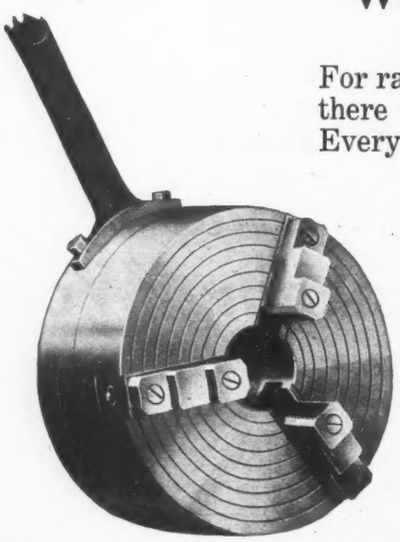
3-B Universal Turret Lathe

There is a reason for their tremendous production capacity

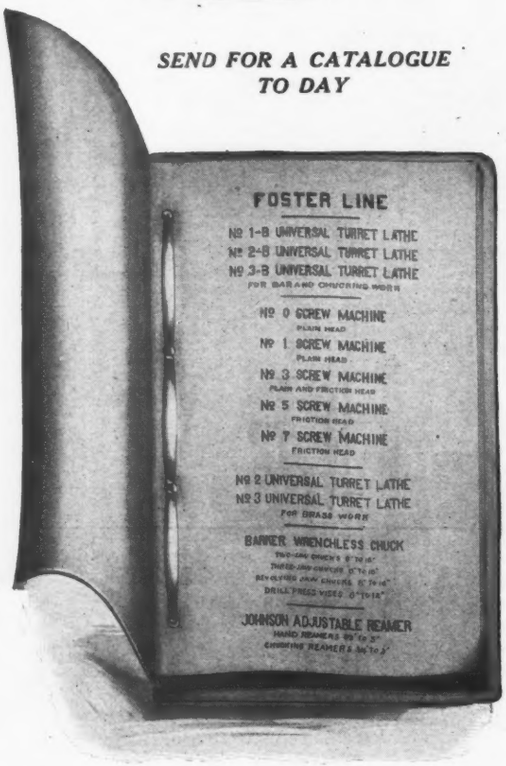
Is our latest catalog in your file?

ELKHART, IND., U. S. A.

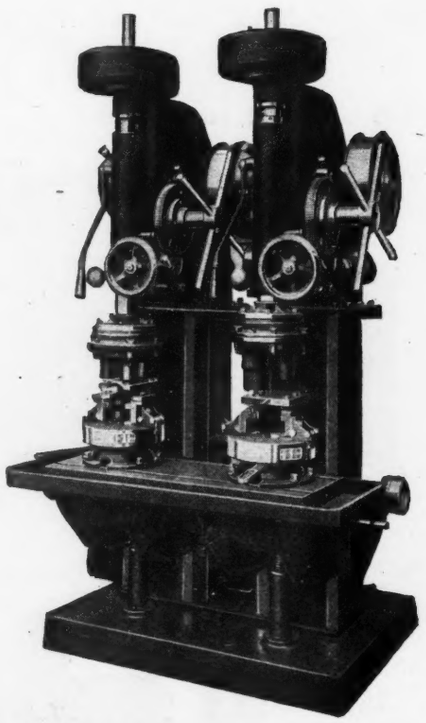
Barker Wrenchless Chucks and Drill Vises with Steel Bodies Qualify.



For rapid production on lathe, drill or milling machine, there is none more productive than the BARKER. Every movement and every moment a productive one. You can increase your production and eventually will. Why not start the investigation now. A Barker Chuck or Vise will start you right.



SEND FOR A CATALOGUE TO DAY



A Two-jaw Barker Jigged for Action on a BAKER BROS. TWO-SPINDLE DRILL.

A movement on the lever and work is instantly held with unshakable grip, again and all is released. Jaws are adjusted to any size. Can you recall a set up more complete?

FOSTER MACHINE COMPANY

ELKHART **Chuck Department** **INDIANA, U.S.A.**

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DAVID T. SIEGEL, 5th Floor, Grand Central Palace, New York, N. W.
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Chucks carried in stock by W. M. PATTISON SUPPLY CO., Cleveland.

"For Forty Years"



THE Shield Brand is your guarantee of higher efficiency. That is, more holes per hour and each hole true—with the result of perfect matching when the work is assembled. We would appreciate an opportunity of going into he matter with you.

THE STANDARD TOOL CO.
Cleveland Ohio, U. S. A.

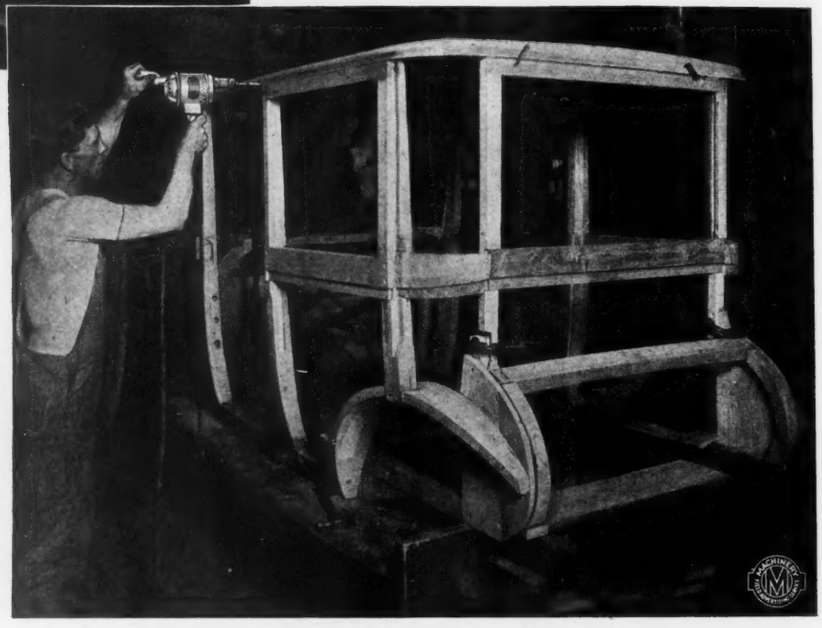
Branch Offices:

New York Store, 94 Reade St.; Chicago Store, 552 W. Washington Blvd.; Boston Store, 1101 Scollay Bldg.; Philadelphia Store, 401 Liberty Bldg.; Great Britain, Burton Griffiths & Co., Ltd., London; France, Burton Fils, Paris; Switzerland, J. Lambercier & Cie, Geneva; Denmark, Nienstaed & Co., Copenhagen; Japan, Horne Co., Ltd., Tokyo; Spain, American Machinery Syndicate of Spain—Barcelona and Madrid; Portugal, American Machinery Syndicate of Spain—Lisbon.

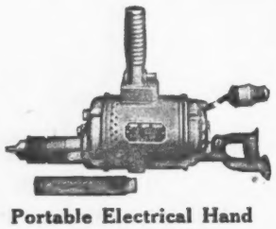
STANDARD



"CINCINNATI" Portable Electric Drills Speed Up Production



Drilling Automobile Body Frames



Portable Electrical Hand or Breast Drill

Made in 5 sizes, ¼", 5/16", ⅜", ½", ⅝" capacities in steel. Single and two speeds. Weight from 8 lbs. up. Armature mounted on ball bearings. Ball thrust bearing for end thrust. Gears hardened and operate in grease. Patented switch in handle.

"Cincinnati" Portable Electric Drills find a wide field of usefulness in the Buffalo plant of the American Body Company, and drill both wood and metal with equal facility. There is a great deal of drilling done in the manufacture of automobile bodies, and the handy "Cincinnati" is just the thing to do it.

In the upper photograph is seen the drilling of a body frame with a "Cincinnati" Electric Drill. The top is put on as shown in lower photograph, further drilling is done, and the structure pegged together.

There's nothing to beat "Cincinnatis" for handiness, economy and general utility. They'll go anywhere—you don't have to move the work around; current consumption is negligible—they use power only when they're working.

Introduce "Cincinnati Electrics"—Drills and Grinders—to your men and plant. You'll find it a paying proposition.

THE CINCINNATI ELECTRICAL TOOL CO.

1501-3-5 FREEMAN AVENUE CINCINNATI, OHIO

New York Office: 50 Church Street *Boston Office:* 259 Franklin Street *Detroit Office:* 2 Goebel Building

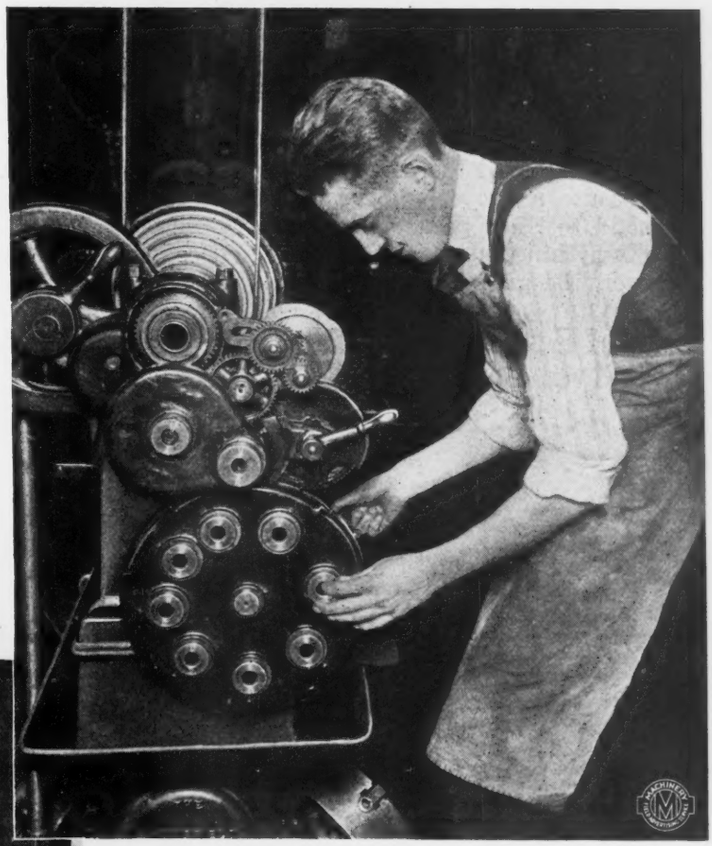
FOREIGN AGENTS: England, S. Wolf & Co., London. Australia, Parke & Lacy Co., Ltd., Sydney. France, R. S. Stokvis & Fils, Paris. Holland, R. S. Stokvis & Zonen, Ltd., Rotterdam. Japan Yamatake & Co., Tokyo. Spain, American Machinery Syndicate, New York City. China, Andersen, Meyer & Co., Ltd., Shanghai.

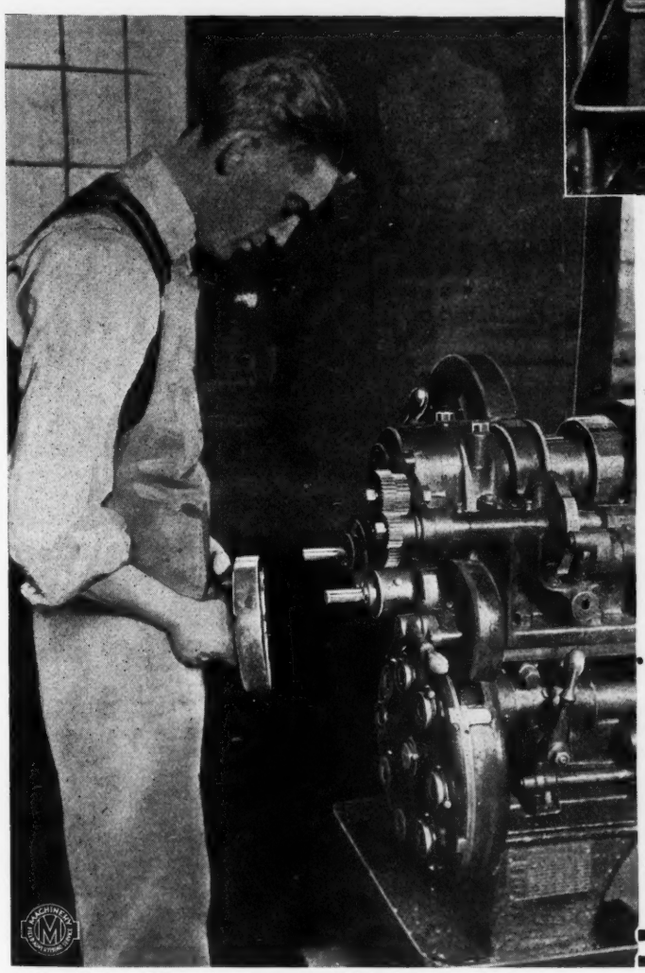
Adjustments Are Quick and Easy On

SPRINGFIELD "IDEAL" LATHES

The Change Gears, For Example—

are mounted on a pivoted disc, as shown in the accompanying photograph. Rotating this disc brings any desired change gear into alignment with the lead screw, the intermediate gear and lead screw extension being readily disconnected and re-engaged by moving two levers. This whole operation requires only three or four seconds and the mechanism is practically fool-proof.





The ratio or case gears are equally simple to adjust. Each pair is enclosed in a case in which their bearings are mounted, making a complete unit, readily removed by hand without even a wrench.

The young operator at the left has just slipped off the 1-2 ratio case to reverse it and so obtain a 2-1 ratio. Two more ratio gear units are regularly furnished with the machine, neatly fitted into the cabinet leg, and a glance at the index plate shows which case and disc gears are necessary to obtain any desired speed and feed.

Let us tell you more about it

THE SPRINGFIELD MACHINE TOOL COMPANY

631 Southern Ave. Springfield, Ohio

Manufacturers of

Springfield Lathes and Shapers



TOOLS FOR PRODUCTION—LOVEJOY INSERTED CUTTERS

The rigid Lovejoy Inserted-Cutter Tool has all the merits of the solid tool, plus thrift. Its construction overcomes the waste of high speed steel characteristic of the solid type tool.

We have used the solid tool for comparison, because a properly forged, correctly shaped solid tool has been our ideal in the absence of anything better. One can readily see, however, the great waste of expensive material, performing no other function than to support a cutting edge.

The Lovejoy cutter won't slip in the holder—won't break at set screw or clamping point—won't clog with chips. It is heat-treated to the highest efficiency—has no unnecessary overhang—no objectionable projections—none of the defects of the welded tool. Lovejoy inserted cutters represent the last word in tool efficiency. Write for lists.

THE LOVEJOY TOOL COMPANY, Incorporated

SPRINGFIELD *Metal Cutting Tools* VERMONT

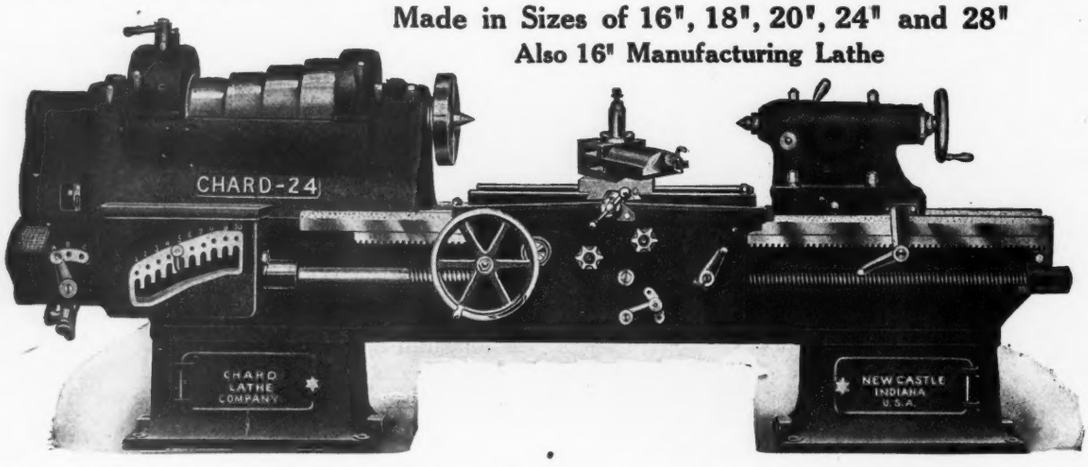


The Culmination of 37 Years' Experience in Lathe Building

THE CHARD 24" QUICK CHANGE DOUBLE BACK-GEARED ENGINE LATHE

Made in Sizes of 16", 18", 20", 24" and 28"

Also 16" Manufacturing Lathe



WE ARE REPRESENTED BY Biggs Watterson Co., Cleveland, O., Dayton, O., Detroit, Mich.; Thompson Mchy. Co., Pittsburgh, Pa.; Monarch Mchy. Co., Philadelphia, Pa.; F. O. Stallman Supply Co., San Francisco, Cal.; Vonnegut Mchy. Co., Indianapolis, Ind.; McMullen Mchy. Co., Grand Rapids, Mich.; Manning, Maxwell & Moore, Inc., New York, N. Y.; Boston, Mass., Seattle, Wash.; Cincinnati, O. Buffalo, N. Y., Milwaukee, Wis., Chicago, Ill., Rochester, N. Y., St. Louis, Mo.; Saxer Mchy. Co., Erie, Pa.; Societe Anonyme Belge, Alfred Herbert, Ltd., Brussels, Belgium.

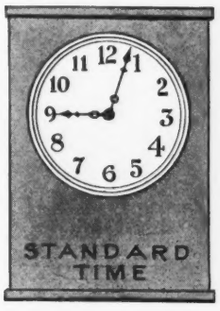
CHARD LATHE CO. **Newcastle, Ind., U. S. A.**

Absolute accuracy and speed in performance, linked with superior design and construction, have made the

CHARD THE LATHE OF GOOD JUDGMENT

in representation the world over. For over thirty-seven years Chard lathe development has produced superior features to assure its demand by discriminating shop men. These years of eminently satisfactory performance are the real test. Let us prove these claims. Details of whole line on request.

They have a STANDARD





When business men wish to keep an appointment they set their watches by the same standard clock. They will then be sure to meet without wasting any valuable time. Not only would a business man be at a loss without his watch, but unless he had a standard by which to keep that watch accurate, he would be greatly handicapped throughout his busy day.

How about YOU?



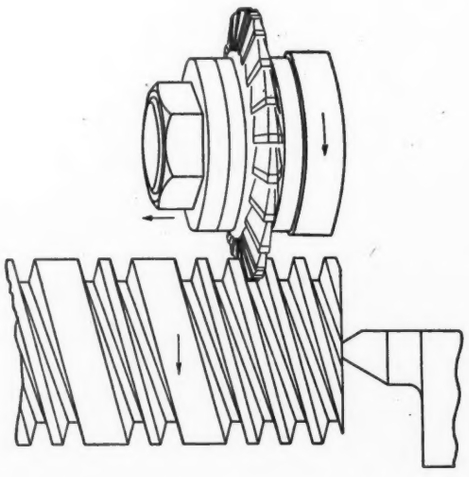


A micrometer is to the mechanic what a watch is to a business man. Unless mechanics have some accurate standard of measurement however, for constantly checking their measuring instruments, close accuracy cannot be depended upon. A set of Johansson Gages serves as an acknowledged standard on which mechanics can absolutely rely. Several sets in different parts of the shop insure greater accuracy in the plant.

Johansson
ACCURACY

C·E·Johansson·Inc·Poughkeepsie·N·Y·

Thread Milling —an L-B Job



When you want accurate threads, worms or lead screws—and each one must be like each other one—the answer is

LEES-BRADNER

Pitches—from the finest threads, up to 2½-inch Circular Pitch worms.

Leads—from 1/32-inch to 100 inches.

Lengths—up to 8 feet, 6 inches.

Diameters—up to 12 inches on Standard Lees-Bradner Thread Millers.

Maximum Swing—up to 27½-inches over bed on Collet Type Lees-Bradner Thread Millers.

Multiple Threads—any number of starts.

Single Cutters—(disc type) up to 7 inches diameter.

Multiple Cutters—(hob or ring type) cutting complete thread at one rotation.

Internal and External Threads.

Possibly you resort to chasing threads on a lathe when you want them accurate—send us your blueprints and we will tell you how to make them still more accurate at lower cost.

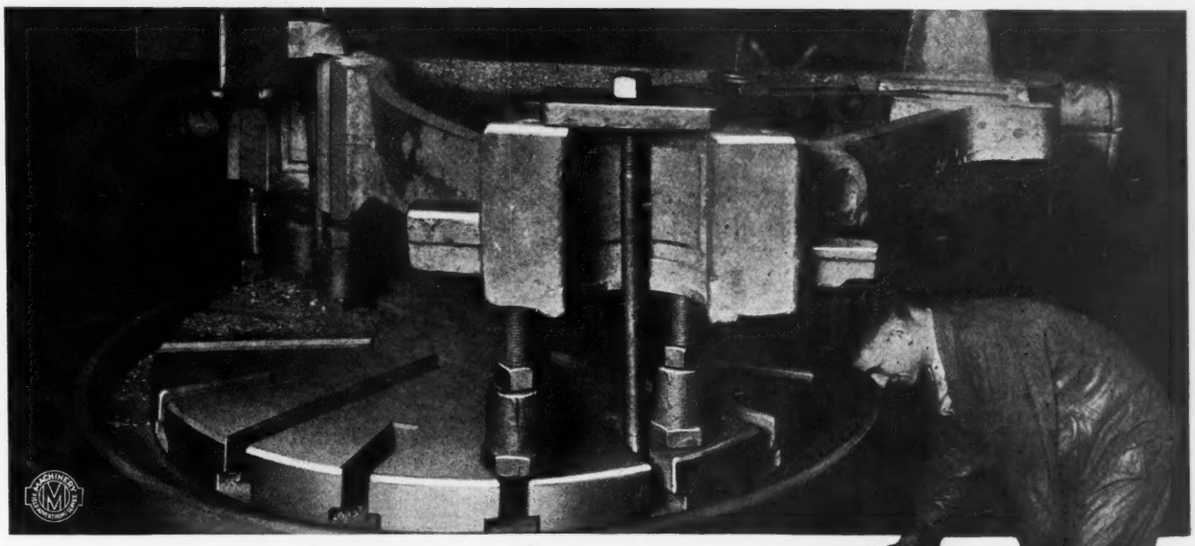
The LEES-BRADNER Co., Cleveland, O.

"To thread or hob is an L-B job"

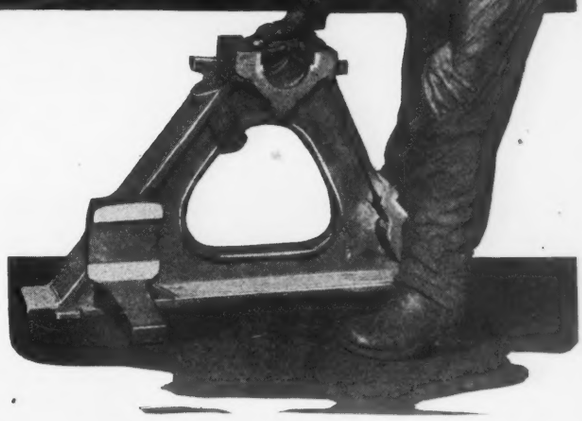
NEWTON

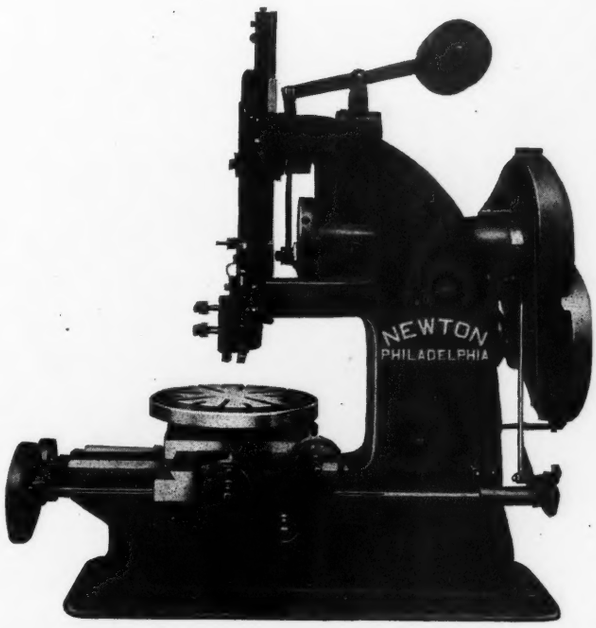
(REGISTERED TRADE MARK)

SLOTTING MACHINES



Fourteen NEWTON Tools In This Plant





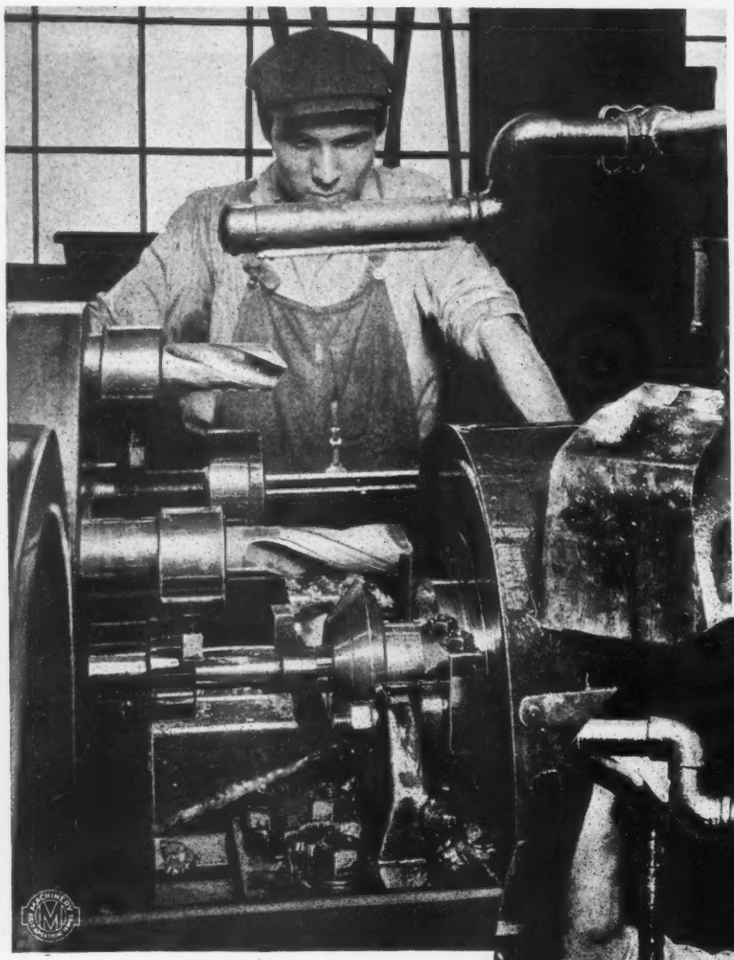
THE American Hoist & Derrick Co. (St. Paul, Minn.) has a number of NEWTON machines—including two NEWTON Slotters. The first Slotter was purchased in 1905—the second installed in 1917. The photograph shows one of them finishing a crank box fit in a frame for a hoisting engine, work that would ordinarily require the services of a planer, but that is finished accurately, speedily and more economically by this method.

We also manufacture Cold Saw Cutting-off Machines, Milling Machines (both horizontal and vertical), Rotary Planers, and Special Machine Tool Equipment for Railway, Electrical Equipment and Automotive shops.

NEWTON MACHINE TOOL WORKS, Inc.

Twenty-Third and Vine Streets **Philadelphia, U. S. A.**

CLEVELAND



Where Every Machine Is Picked for Accuracy, Durability and Production

There's no finer shop in the country than the Cincinnati-Bickford Tool Co.'s plant at Cincinnati, Ohio—a model establishment in every way and equipped throughout with the best that can be obtained.

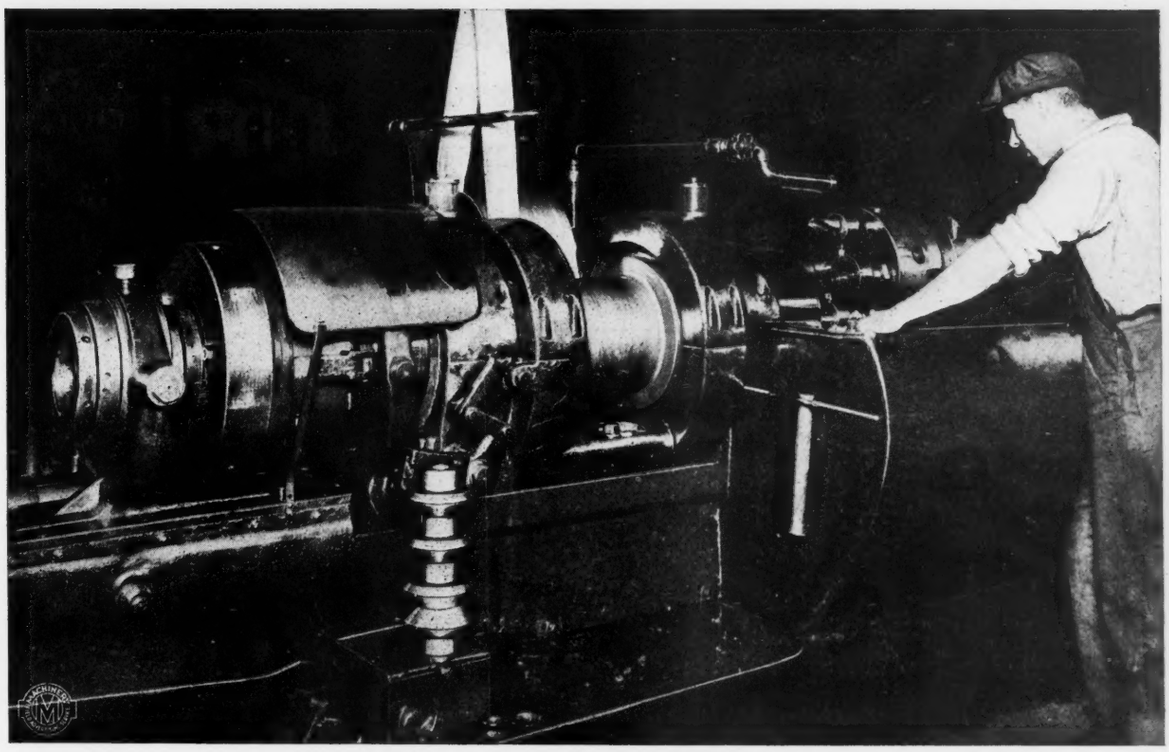


The accompanying photographs show the Cleveland Automatic in this up-to-date plant, machining bevel gear blanks for Cincinnati-Bickford No. 3 Radial Drills. Material is cold rolled steel, 30-point carbon, and the operations (see sketch on the opposite page) are performed in the following sequence: 1st, feed; 2nd, center; 3rd, drill and form; 4th, ream and cut off.

THE CLEVELAND AUTOMATIC

AGENTS: J. B. Anderson, 211 Gowan Avenue, Mt. Airy, Philadelphia, Pa. Herbert E. Nunn, 565 West Washington Street, Chicago, Ill. England, Chas. Churchill & Co., London, England. Japan, Andrews & George Co., Tokyo, Japan. Belgium, Henri Benedictus, Brussels, Belgium.

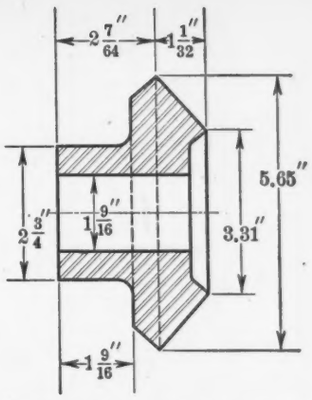
AUTOMATICS



Output is Limited Only by the Capacity of the High Speed Cutting Tools

Production is one completed blank every 16 minutes, and accuracy and finish are all that could be desired.

Simplicity and accuracy, low maintenance costs and a wide and practical range of application to modern manufacturing problems are the basis of our claim for the pre-eminence of Cleveland Automatics. These machines are made in styles and sizes to handle bar work from 1/8" to 7 3/4" diameter up to 18" long; they are also readily adaptable to a wide variety of special second operation jobs.



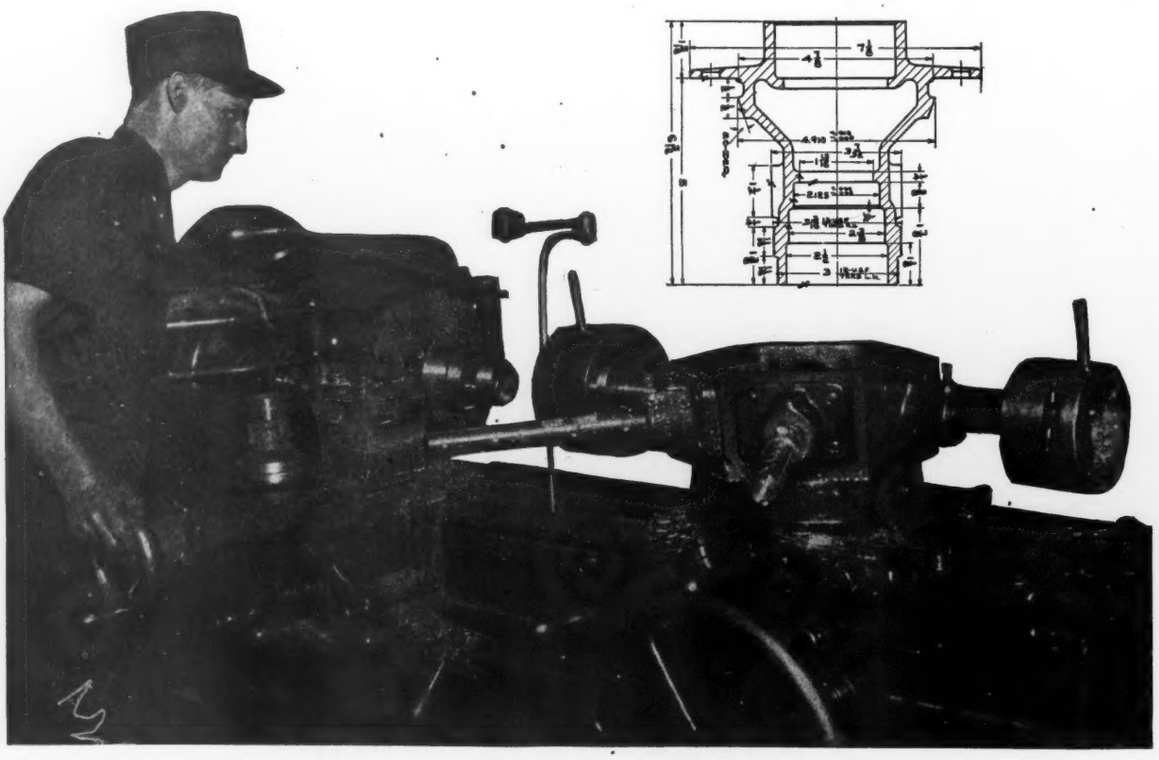
We are always glad to furnish estimates from samples or blueprints. Complete description of all standard and many "special" machines in catalog.

MACHINE CO., Cleveland, O., U.S.A.

AGENTS: Denmark and Norway, Chr. A. Herstad, Copenhagen, Denmark. France, Holland and Colonies, R. S. Stokvis & Zonen, Paris, France and Rotterdam, Holland. Switzerland, J. Lambercier & Co., Geneva, Switzerland. Spain and Portugal, American Machinery Syndicate, 35 West 39th Street, New York, N. Y.

W & S Turret Lathe

The manufacturer in whose plant this photograph was taken gave us permission to show it, but asked us not to mention his name or the time needed to finish the wire wheel hub. They make them so fast on their W & S 2-A they don't want to give their cinch away.



No. 2-A Finishing a Wire Wheel Hub

THE WARNER & SWASEY

BRANCH SALES OFFICES: **NEW YORK: Singer Building** **BOSTON: Oliver Building**

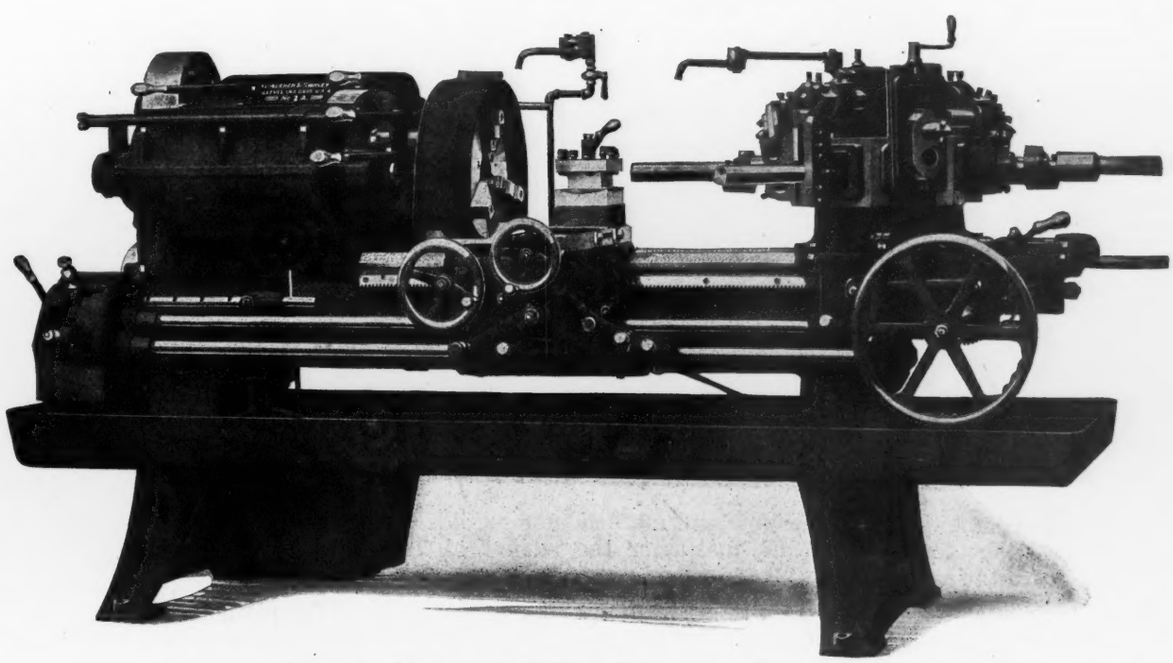
DOMESTIC AGENTS:
Fulton Supply Co., Atlanta, Ga.
Young & Vann Supply Company, Birmingham, Ala.
Woodward, Wight & Company, New Orleans, La.
Salt Lake Hardware Company, Salt Lake City, Utah.
Smith-Booth-Usher Company, Los Angeles, Cal.
Fred Ward & Son, San Francisco, Cal.
Portland Machinery Company, Portland, Ore.
Hallidie Machinery Company, Seattle, Wash.
Henry & Bolthoff Mfg. & Supply Co., Denver, Col.
Peden Iron & Steel Co., Houston, Texas.

CANADIAN AGENTS:
A. R. Williams Machinery Company, Ltd., Toronto, Winnipig Vancouver and St. John.
Williams & Wilson, Ltd., Montreal.

Pays Big Dividends

Every day more manufacturers are finding that the accuracy and speed of W & S Turret Lathes pay large dividends when used to finish hubs, gear blanks, fly wheels, pistons, piston rings and a lot more automobile parts. How about your turret lathe work?

Send us your blue prints and let us show you



No. 2-A Universal Hollow Hexagon Turret Lathe

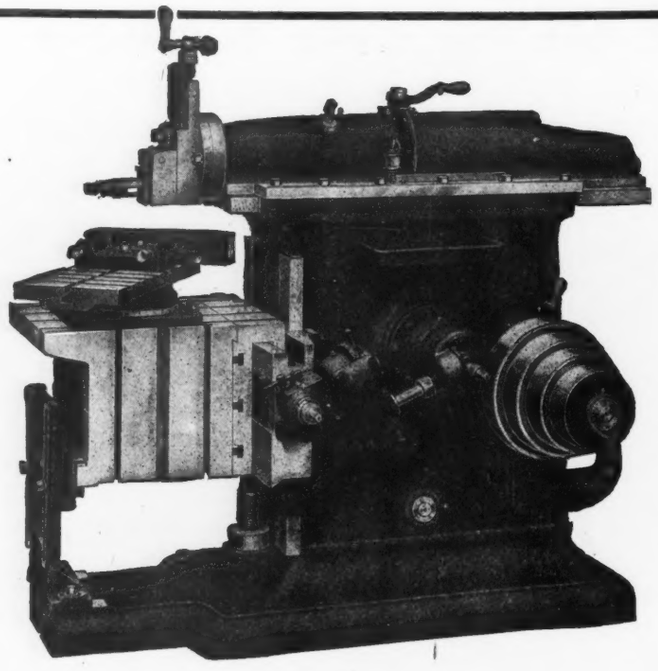
COMPANY, Cleveland, Ohio

BUFFALO: Iroquois Building DETROIT: Ford Building CHICAGO OFFICE and SHOW ROOM: 618-622 Washington Blvd.

FOREIGN AGENTS:

Charles Churchill & Company, Ltd., London, Birmingham, Manchester, Bristol, Newcastle-on-Tyne, Glasgow.
Allied Machinery Company, Paris, Turin, Zurich, Barcelona, Brussels.
Wilhelm Sonesson Company, Malmo, Copenhagen, Stockholm, Gothenburg.
R. S. Stokvis & Zonen, Rotterdam.
Benson Brothers, Sydney, Melbourne, Adelaide.
McLeod & Company, Calcutta.
Yamatake & Company, Tokyo.
Andersen, Meyer & Company, Ltd., Shanghai, Tientsin, Pekin, Hankow, Canton, Yamanfu, Changhau, Kalgan.
Brossard, Mopin & Company, Saigon, Singapore, Haiphong.

Can You Answer These Questions?



WHICH IS THE BETTER?

Soft Machinery Steel Shafts; or High Grade Spindle Steel Shafts locally Hardened at Journals?

Squirt Can Methods of Oiling; or Ring-oiling Removable Bushings?

Gray Iron Castings; or Semi-steel (10 to 30% McLain Process)?

Plain Countershaft Bearings with dirty drip cups; or Hyatt Roller Bearings in Loose-pulley and Boxes, oil-tight?

Spur; or ALL Helical Driving Gears (Generated)?

A Prop under the Table; or a Real Table Support, self-adjusting, self-aligning and closely gibbed to Table at its extreme end, holding firmly on upward and lateral thrusts, as well as on downward pressure?

The usual inefficient Feed (awkward and dangerous for operator); or the Queen City Quick Change Feed (absolutely safe with NO moving handles), always on the return stroke and as easy to control as an electric switch?

Queen City Shapers are neither new and untried, nor so old that they are depending on past reputation; designed in 1903, just after the advent of High Speed Steel, and improved up to the minute.

Queen City Shapers are Superior to ALL others in every one of the following features: Accuracy, Handiness, Durability and Power, and, these features being combined in our shapers, make them Far Superior.

Champions in Appearance, Construction, Rigidity and Production.

16- 20- 24- and 28-inch Back Geared Crank Shapers, Cone or Single Pulley, Constant or Adjustable Speed Motors, Plain or Universal Table, etc. Investigate!

THE QUEEN CITY MACHINE TOOL COMPANY

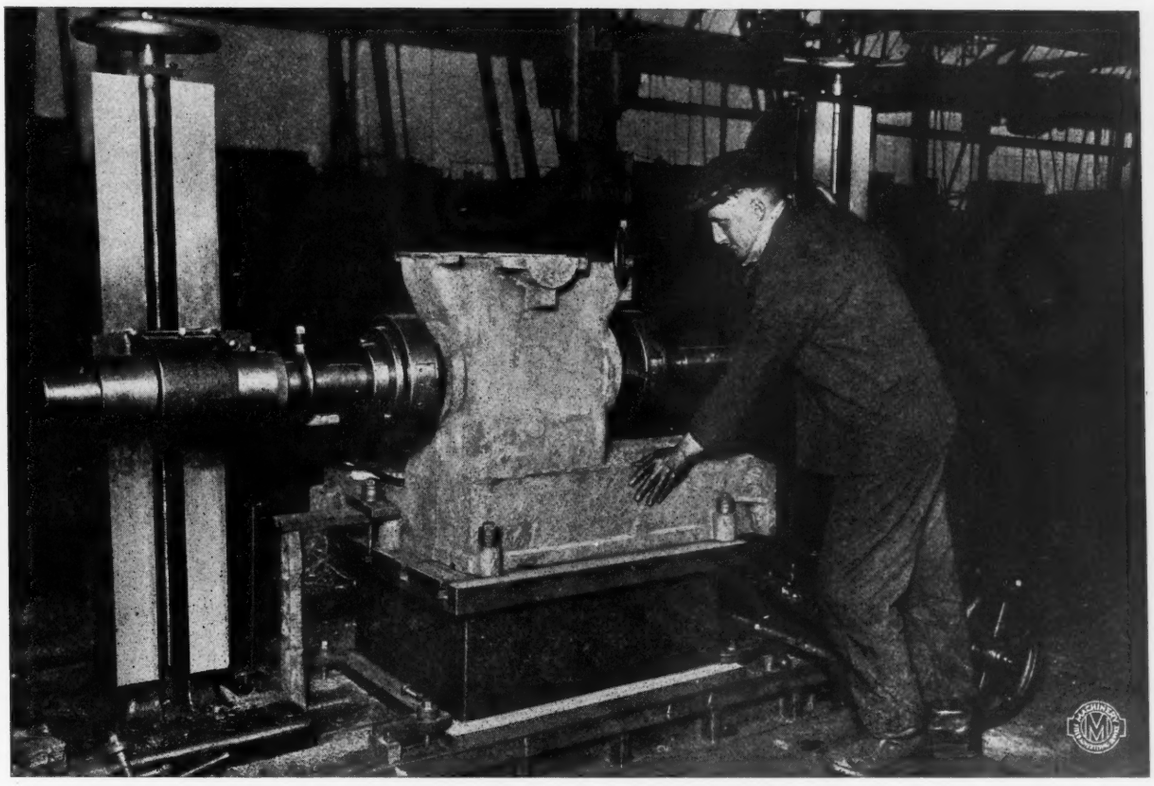
1401-7 Sycamore Street **CINCINNATI, OHIO, U. S. A.**

Agents in the principal cities of the world. We sell direct to user in Cincinnati District; send us your inquiries and you will get prompt and efficient service.

Foreign Agents: Alfred. Herbert, Ltd., for Great Britain, India, Belgium, France and Spain.

PEDRICK COLUMN BORING MACHINE

Chosen for the Most Particular Work



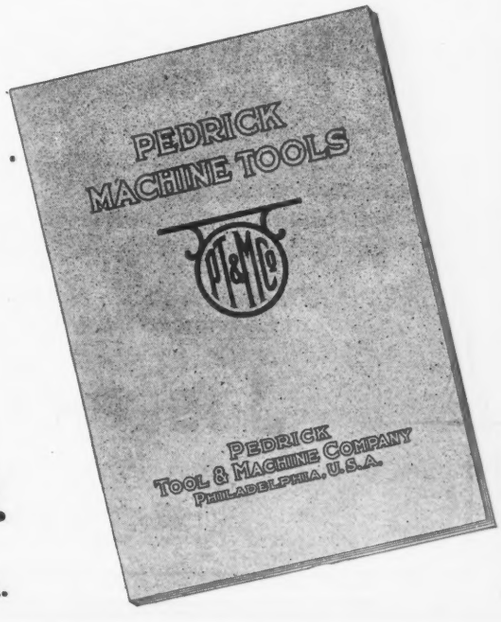
It is a significant fact that when the boring and facing operations in the Albro-Clem Elevator Company, Philadelphia, Pa., are more important than usual, the Pedrick Column Boring Machine is generally selected for the work.

In the Pedrick No. 1 Column Boring Machine shown, a cast-iron electric elevator worm gear housing is bored, reamed and faced.

The first operation is the facing of a boss 10½" diameter on each side of the housing. Boring is next performed, starting from a cored hole, and finishing to 7" in diameter. Hole is bored through, *i.e.*, two bearings are formed, one in each side of the casting. These are for the worm shaft. The worm wheel shaft is also bored on this machine and the location of the center distance must be extremely accurate in order that worm and worm wheel shall mesh properly.

Tell us your problems and we'll advise you which units of the Pedrick line will best solve them.

Send for a copy of our New Catalog. It contains a List of Unusual Tools, Machines and Appliances for Shop and Factory.



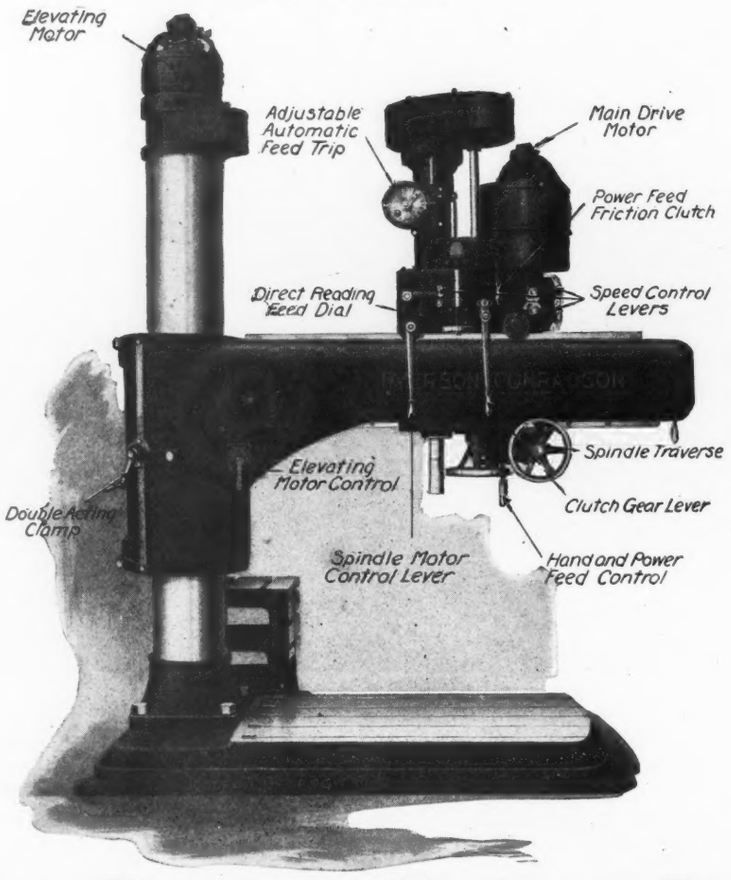
PEDRICK TOOL & MACHINE CO.

3639 N. LAWRENCE STREET

Philadelphia Pa., U. S. A.

The Ryerson-Conradson Four-Purpose Radial

U. S. AND FOREIGN PATENTS



Drilling—Tapping—Boring—Reaming

Can be performed on this machine with equal efficiency

Power consumption practically 40% less than that of other radial drills.
All shafts concentrated in head.
Splash oiling system.
All bevel gears and friction clutches for tapping, eliminated.
Exceptional feed range. Sixteen feeds from .005" to .370".

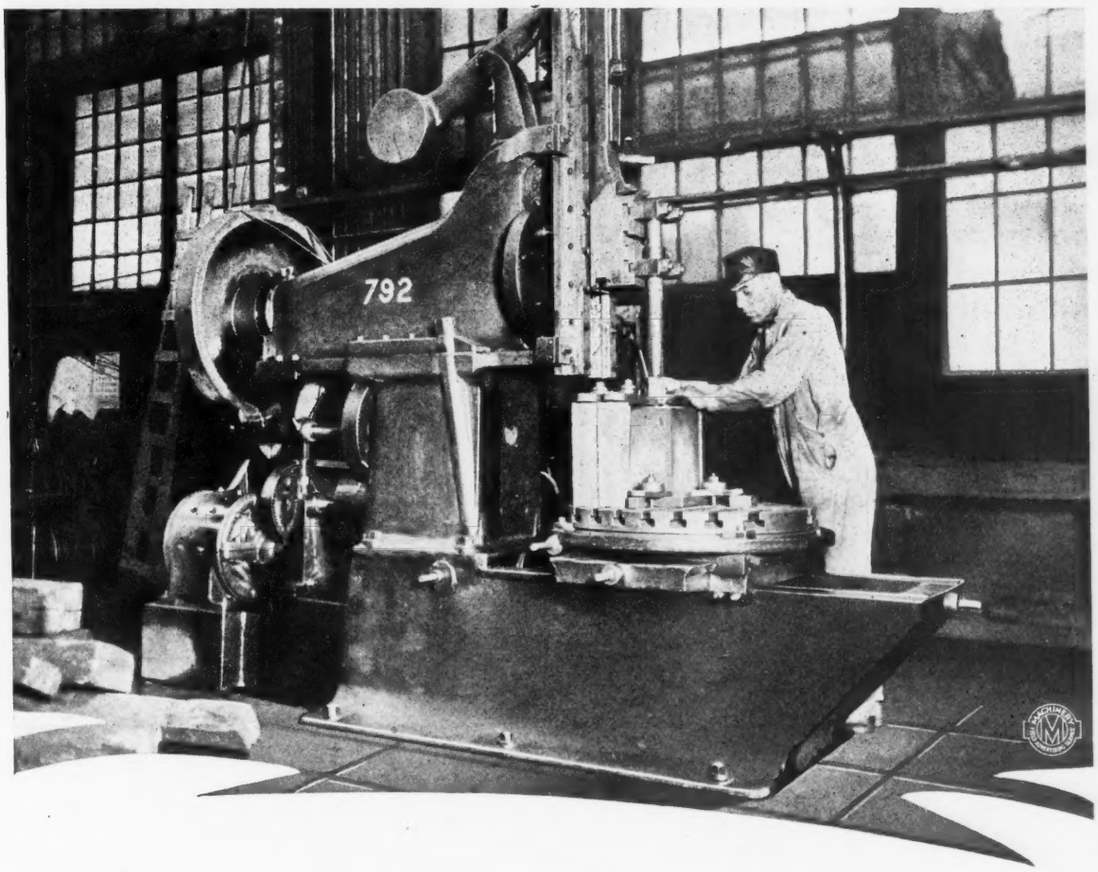
The new Bulletin No. 4001 describes completely, the special features and advanced design of the Ryerson-Conradson Radial. Write for it!

JOSEPH T. RYERSON & SON

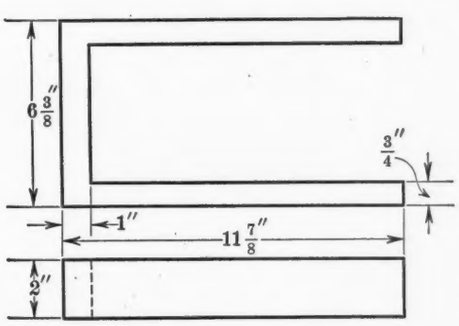
MACHINERY

CHICAGO ST. LOUIS DETROIT BUFFALO NEW YORK

THE DILL SLOTTER



Installed to Solve One Problem, It Solved Many



Write for your copy of "The Dill Slotter in Action"

When this Dill Slotter was ordered by the Struthers & Wells Co., of Warren, Pa., it was scheduled to perform a specific piece of work which might otherwise have necessitated expensive special equipment. That work was machining deep fork-shaped sections of large castings. The Dill traveling head, of course, made this operation a simple one, but it was soon seen that the Dill was equally suitable for a great many other varieties of work, and its operations were soon extended.

The photograph shows the machining of connecting rod straps. These steel forgings are machined both inside and out. About 1/16" of stock is removed on the inside and 3/16" from the outside. Dimensions are shown in sketch. These parts are clamped in a fixture, six being machined at a time.

T. C. DILL MACHINE COMPANY

THE DILL SLOTTER PEOPLE

PHILADELPHIA, PA.

FOREIGN AGENTS: Alfred Herbert, Ltd., British Isles. Alfred Herbert, Ltd., Yokohama, Japan. Societe Anonyme Belge, Alfred Herbert, Brussels, Belgium. Societe Anonyme, Alfred Herbert, Ltd., Paris, France. Societa Anonima Italiana, Alfred Herbert, Ltd., Milan, Italy. Allied Machinery Co., S. A. E., Barcelona, Spain. Monteiro Gomes, Ltda., Lisbon, Portugal. Allied Machinery of America, Shanghai, China. Benson Brothers, Ltd., Sydney, Australia.

Don't Scrap a Set of Hartness Chasers because of the breakage of a single chaser; *replace the broken chaser*

It is only necessary to grind the set to uniformity.

HARTNESS CHASERS Are Interchangeable

This Interchangeability of Hartness Chasers is possible because of our special method of manufacture.

JONES & LAMSON MACHINE COMPANY

DIE DIVISION

SPRINGFIELD VERMONT, U. S. A.

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Boyer-Campbell Co., Detroit
Carey Mchy. & Supply Co., Baltimore
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Robinson, Cary & Sands Co., St. Paul and Duluth
A. V. Wiggins & Co., Syracuse
The Fairbanks Company, Albany, New York; Buffalo, New York; Bridgeport, Connecticut; Hartford, Connecticut; Providence, Rhode Island, Boston, Massachusetts; New York, New York; Newark, New Jersey; Scranton, Pennsylvania; St. Louis, Missouri; Birmingham, Alabama; New Orleans, Louisiana.

FOREIGN AGENTS:

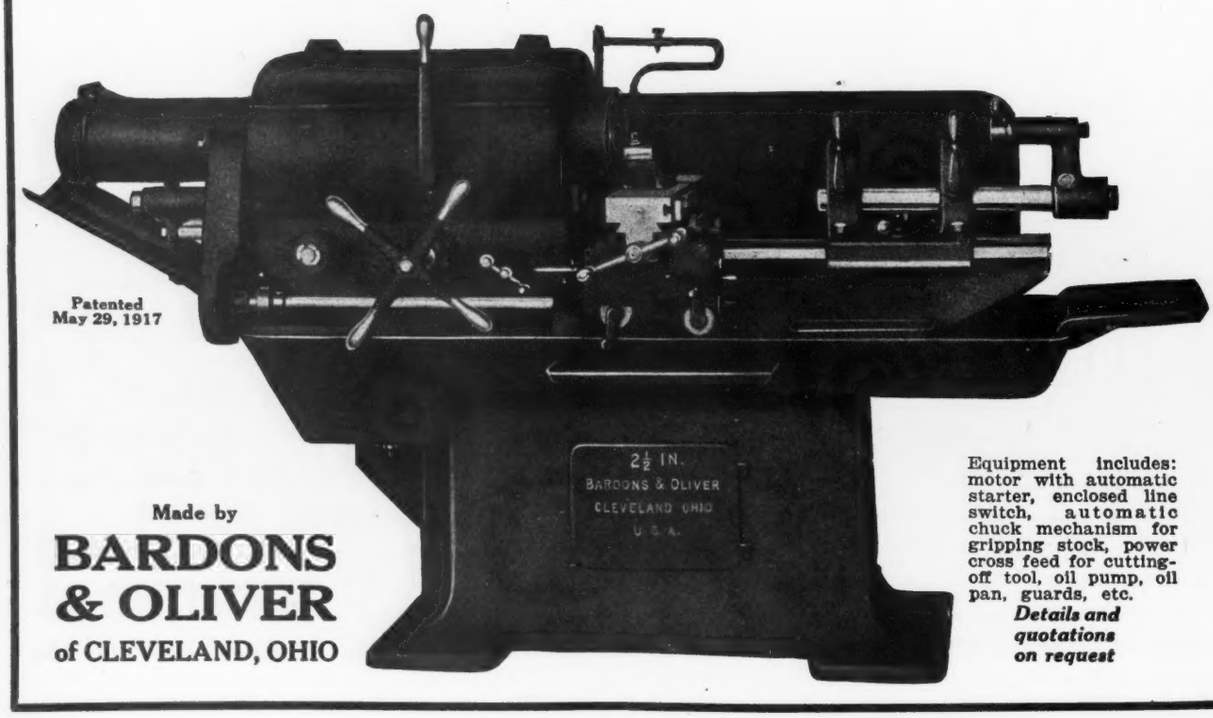
For France, Spain and Belgium: F. Auberty & Co., 91 Rue de Maubeuge, Paris.
For Holland: Spliethoff, Beeuwkes & Co., Rotterdam
For Australia: McPherson's Pty., Melbourne
Japan, Manchuria, Korea, Formoso Mitsui Bussan Kaisha, Ltd., Tokyo, Japan

Accelerated Speed Cutting-Off Machine

—the Best on the Market

The method of "acceleration" on which we base our claims is a special arrangement of the variable speed motor which automatically increases the spindle speed as the cutting tool approaches the center.

This feature, coupled with the high-grade material and workmanship used in manufacturing this powerful and accurate cutting-off machine, has made it the standard in many leading shops.



Patented May 29, 1917

Equipment includes: motor with automatic starter, enclosed line switch, automatic chuck mechanism for gripping stock, power cross feed for cutting-off tool, oil pump, oil pan, guards, etc.

Details and quotations on request

Made by

BARDONS & OLIVER

of CLEVELAND, OHIO



Boyer Chipping Hammer, Type K, finishing large cast-steel gear

Do you chip pneumatically?

HERE is a widely popular Boyer Chipping Hammer—the Type K—that is ideal for general machine shop, foundry and allied work.

Boyer Chipping Hammers have the same built-in qualities as the famous Boyer Riveting Hammer itself; fast-hitting power, freedom from wasteful vibration, accurately fitted air-tight parts made from finest materials carefully heat treated, and day-in-day-out dependability that spells *low upkeep.*

Boyer Chipping Hammers are made in a wide variety of types and sizes for every conceivable chipping, calking, beading, scaling or light riveting job. And *stock delivery* is procurable from any Company Branch.

Ask for new instructive Pneumatic Tool Catalog 560.

Chicago Pneumatic Tool Company

Chicago Pneumatic Building • 6 East 44th Street • New York

*Sales and *Service Branches all over the World*

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BOYER PNEUMATIC HAMMERS··LITTLE GIANT PNEUMATIC AND ELECTRIC TOOLS
CHICAGO PNEUMATIC AIR COMPRESSORS··VACUUM PUMPS··PNEUMATIC HOISTS
GIANT OIL AND GAS ENGINES ROCK DRILLS ·· COAL DRILLS

BOYER HAMMERS

The world's standard *wherever rivets are driven*

TRADE W.F. J.B. MARK

Complete Line

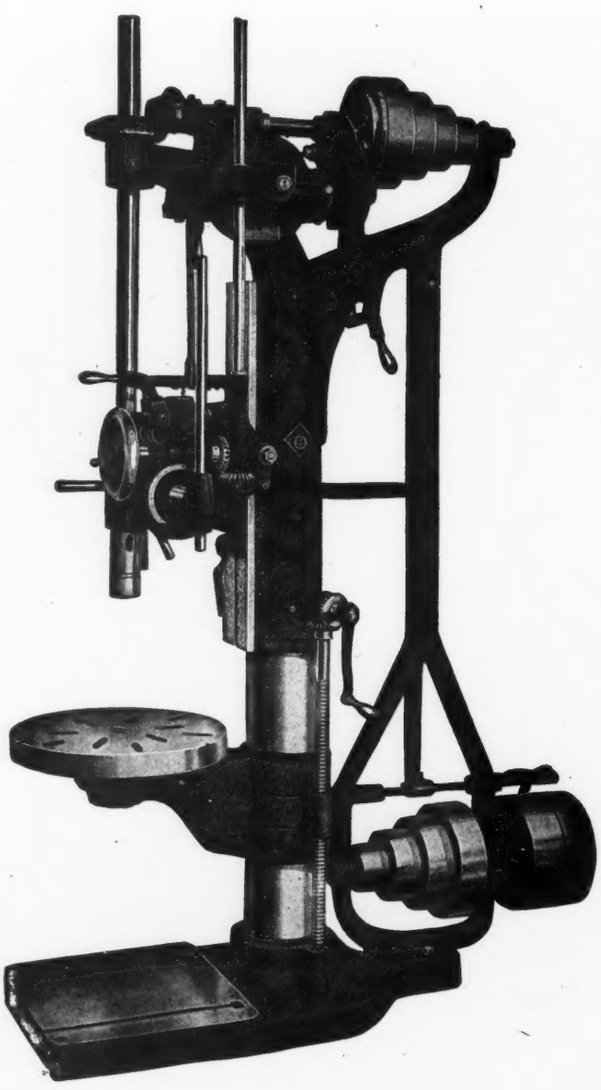
8-inch to 50-inch Swing

(With or without Tapping Attachment)

Upright Drills

Horizontal Drills

Gang Drills



BARNES DRILLS

Accuracy
Convenience of Operation
Strength

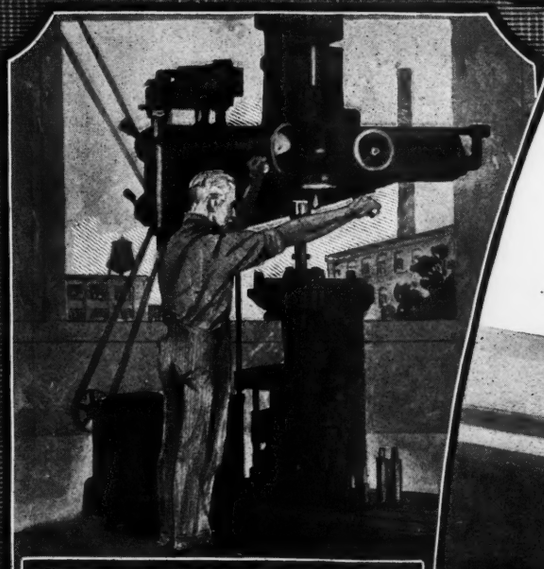
MADE BY

W. F. & JOHN BARNES CO.

231 RUBY ST. ROCKFORD, ILL., U.S.A.

NEW DEPARTURE

Ball Bearings

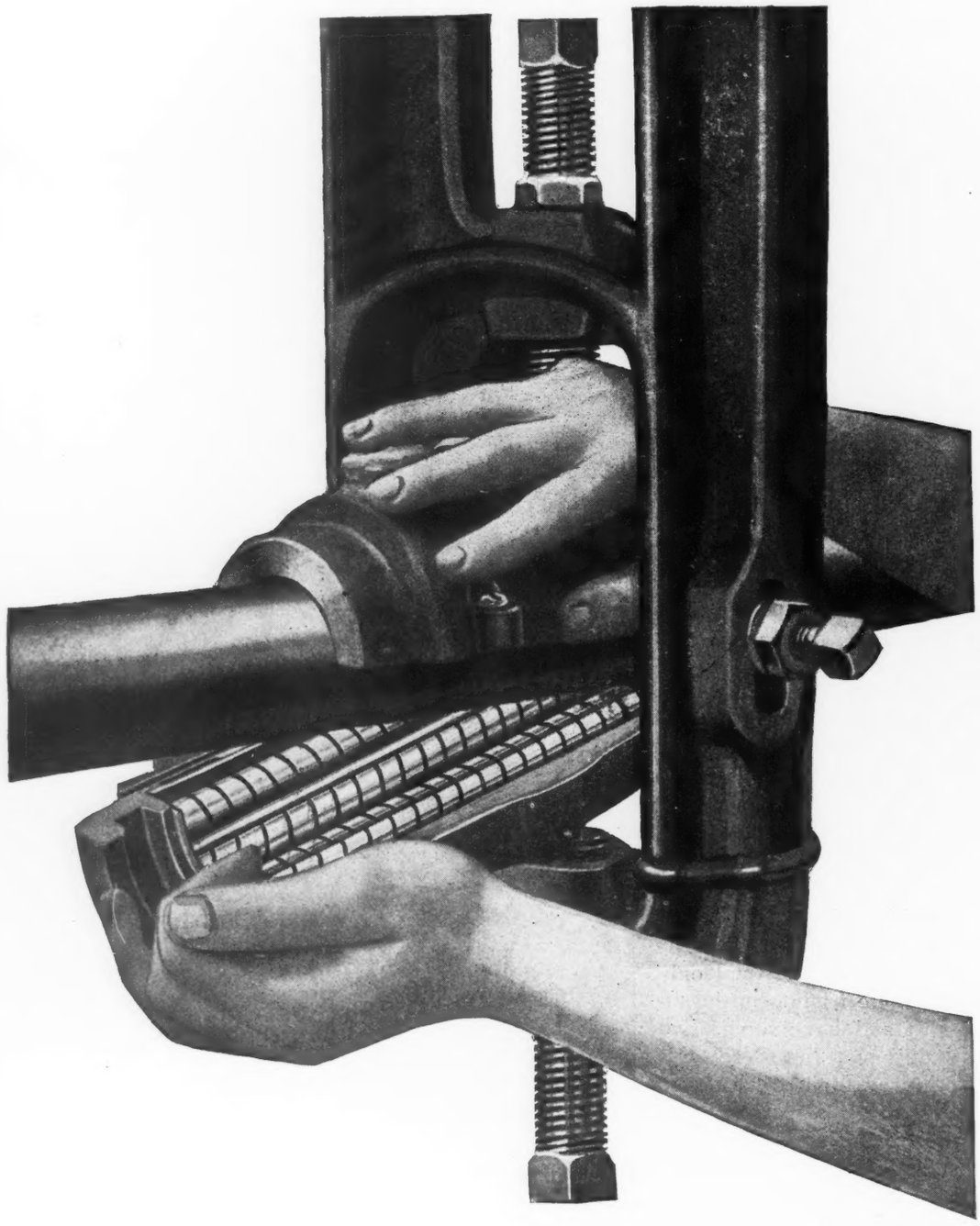




Machine designers prefer New Departure Ball Bearings because they not only eliminate friction to the utmost and have superlative endurance, but New Departure Engineering Data Bulletins are most helpful to those who lay out new installations. Are you receiving the monthly bulletin service? 614.

New Departure Manufacturing Co.
Bristol Connecticut
Chicago Detroit
Coaster Brake Licensee

WHY ARE MODERN MEN'S SHIRTS



HYATT BEARINGS

LIKE HYATT BEARING HANGERS?

THEY'RE SPLIT!

to Make Them Easy to Put On

HYATT Roller Bearing Hangers are split throughout and can be applied to any shaft at any time without disturbing couplings, collars or pulleys. The box is opened, applied around the shaft and the two halves screwed together. Any millwright can properly apply the bearing.

Specify Hyatt Roller Bearing Hangers—their simplicity makes them trouble proof.

Write at once for Bulletin No. 125

MOTOR BEARINGS DIVISION
DETROIT, MICHIGAN

HYATT ROLLER BEARING COMPANY
INDUSTRIAL BEARINGS DIVISION
NEW YORK, N. Y.

TRACTOR BEARINGS DIVISION
CHICAGO, ILL.

D-158

FOR LINE SHAFTS

Are Your Countershafts



HYATT BEARINGS

Assets or Liabilities?



Hyatt Bearings Are Assets

If you are furnishing your customers old-fashioned, plain bearing countershafts with your modern, improved machine tools, you are selling them liabilities—expenses—additional burdens to carry.

Much of the time and money spent in refining the design and construction of a good machine tool is lost when your customers connect it to an inferior, power and lubricant wasting countershaft.

Hyatt Roller Bearing Countershafts are assets—they save power, lubricant, and are dependable. They deliver maximum power for useful work, and operate for years with no appreciable wear.

Satisfied customers are assets. See to it that you satisfy your customers by supplying Hyatt equipped countershafts.

HYATT ROLLER BEARING COMPANY
Industrial Bearings Division

Motor Bearings Division
DETROIT, MICH.

NEW YORK, N. Y.

Tractor Bearings Division
CHICAGO, ILL.

Manufacturers of Bearings for Mine Cars, Ore Cars, Steel Mill Cars, Roller Tables, Trolleys, Cranes, Hoists, Machine Tools, Line Shafts, Countershafts, Concrete Machinery, Textile Machinery, Conveyors, Lift Trucks, Industrial Trucks, Railway Service Cars, Storage Battery Locomotives, etc.

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FOR COUNTERSHAFTS



Graphic Story of Belt Making

The Chas. A. Schieren Company announce that the moving pictures of actual Belt Making—from the hide to the finished belt—are now completed and will be shown free of cost.

These moving pictures have been prepared for us by the "Universal," under the guidance of our experts at our tanneries, Bristol, Tenn., and at our factories in New York City, and are strictly industrial, educational and interesting to every belt buyer and user.

They are under our own supervision and will be shown in your offices, factories, etc., only on request.

If you are interested, please advise our Advertising Department and bookings will cheerfully be made to comply as near as possible with your wishes.

CHAS. A. SCHIEREN COMPANY

Advertising Department

73 FERRY STREET NEW YORK, N. Y.

20-8



Hundreds of "Pierce Arrow" Parts Are Measured With

SLOCOMB MICROMETERS

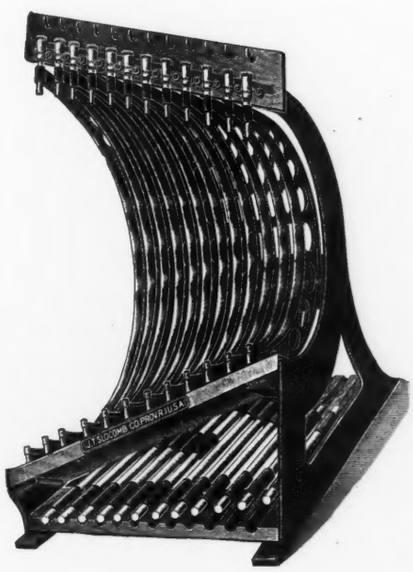
SLOCOMB MICROMETERS ARE USED ALL OVER THE WORLD

Reg. U. S. Pat. Office

THIS photograph shows a 16-17″ Slocomb Micrometer being used to measure a brake shoe—one of hundreds of automobile parts measured with Slocomb Micrometers at the Pierce Arrow Motor Car Company's big plant at Buffalo, N. Y.

Slocomb Micrometers are used in practically every department throughout this entire plant—their unusual durability being well adapted to the hard service involved.

This is due to their distinctive one-piece hardened tool steel screw with four times the usual bearing on the nut, I beam construction insuring rigidity without undue weight, a solid tool-steel anvil, one-piece sleeve, an exclusive uniform tension spring between the adjusting nuts and other practical advantages which have given the "Slocomb" the reputation of being *"the longest lived micrometer that can be bought."*



Catalog 16 for details

J. T. SLOCOMB CO.

PROVIDENCE R. I., U. S. A.

CHICAGO REPRESENTATIVE: R. R. Street & Company, Machinery Hall. PACIFIC COAST REPRESENTATIVES: The Charles A. Dowd Sales Co., 320 Market St., San Francisco. FOREIGN AGENTS: England: Chas. Churchhill & Co., Ltd., London. Birmingham, Manchester, Newcastle-on-Tyne and Glasgow. Japan: Alfred Herbert, Ltd., Yokohama. Italy: Chas. Civita, Milan. Australia: Edwin Wood, Pty., Ltd., Melbourne and Sydney.

Gray Planers



Are Standard Equipment at Waterbury Farrel

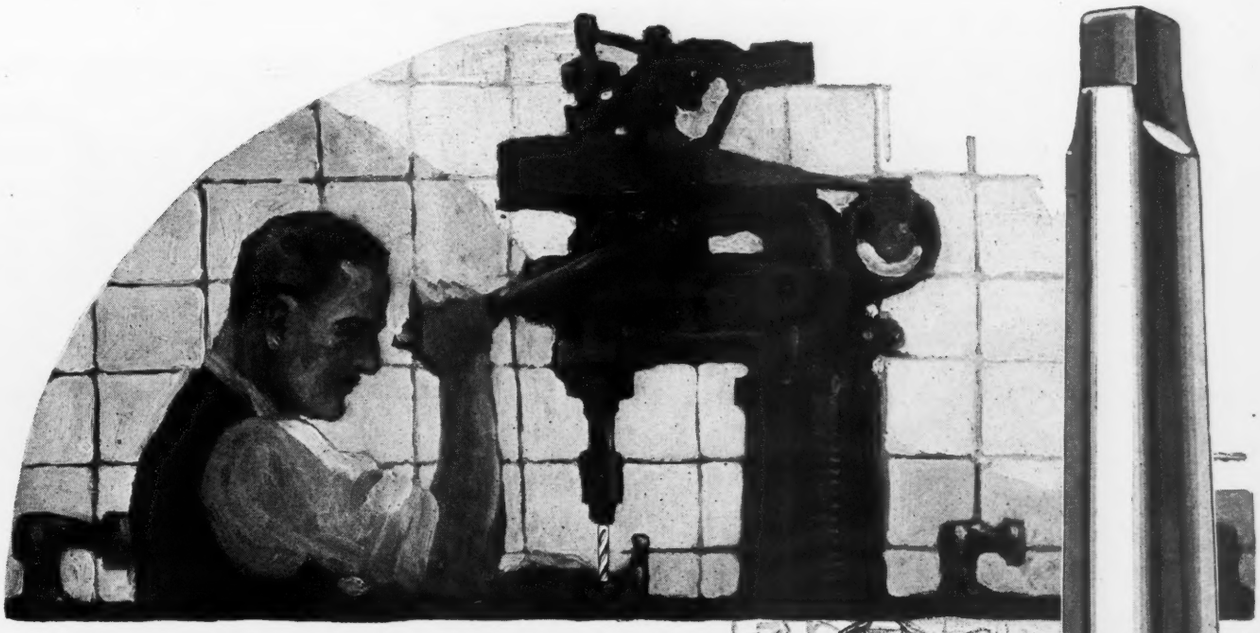
These are two of the twenty-two Gray Planers in the plant of the Waterbury Farrel Foundry and Machine Co., at Waterbury, Connecticut. The right hand machine is planing up to a shoulder—a job where accurate reversal is absolutely essential. The operator isn't worried; he has confidence in his Gray.

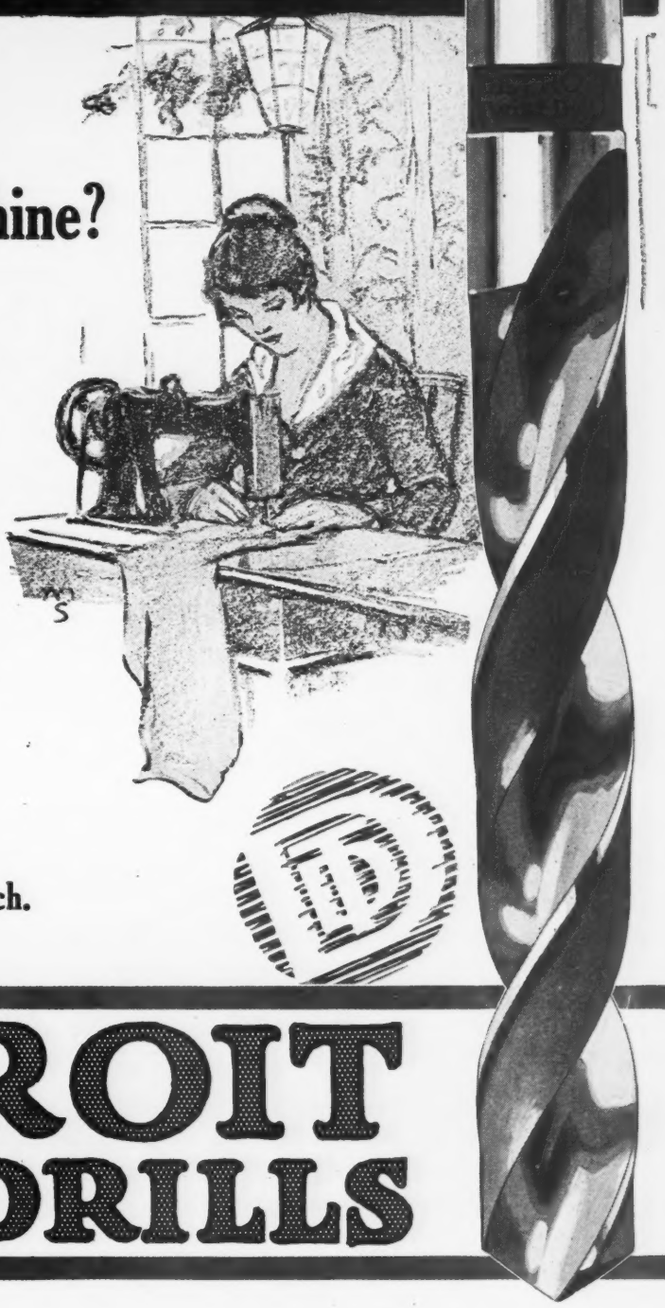
Exceptionally wide belts give these planers great driving power without excessive belt speeds. A simple powerful belt shifting mechanism gives easy control of reversing without a slam. Aluminum pulleys contribute as well to speedy reversal.

There are many other good reasons why so many Gray Planers are working in this shop and our catalog gives them all. Why not investigate?

THE G. A. GRAY COMPANY

CINCINNATI OHIO, U. S. A.





How Many Holes Are Drilled in a Sewing Machine?

Merely look at the arm, the bed plate, the face plate, and the stand of a sewing machine and count the number of drill holes in them.

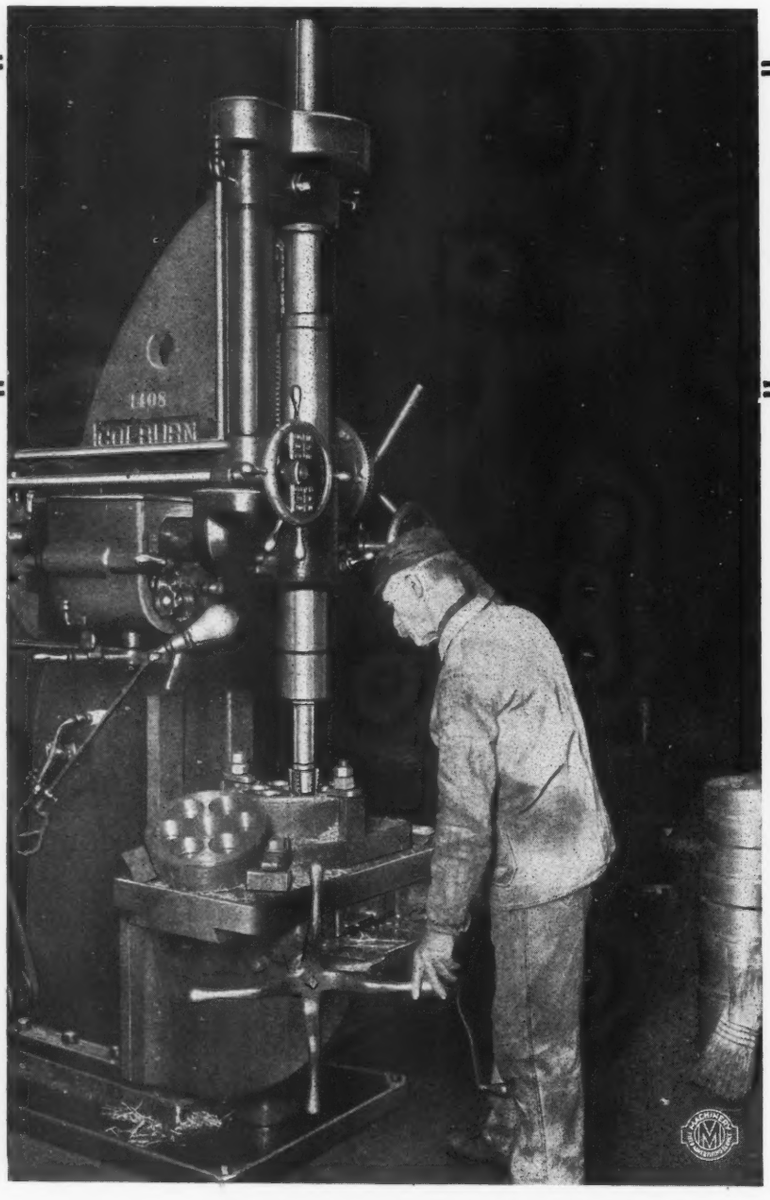
This will increase your appreciation of the twist drill's importance in helping to fashion the utilities which contribute to the comforts of your daily life. Also, it will emphasize how Detroit Twist Drills serve you by serving those who build these utilities.

And in the sewing machine industry, too, Detroit Twist Drills are used because they give more accurate holes with less regrinding and less cost for power.

In Your Next Order Specify
Detroit Twist Drills

Detroit Twist Drill Company, Detroit, Mich.

DETROIT TWIST DRILLS



CO

Builders of

The Capacity of the D-4 Colburn Heavy Duty Drill Press is Limited Only by the Tools it Drives

THE work-in-process when the above photo was taken was valve cages of forged steel, 11½" outside diameter and 3⅜" thick, with seven 2¼" holes rough punched through them—one in the center, the rest centering on a circle 7⅛" diameter. The operations performed on these parts with the help of the Colburn Heavy Duty Drill Press are as follows: 1st, rough bore the seven holes to 2 15/16" diameter; 2nd, rough ream with stepped tooth taper reamer; 3rd, finish ream to size. This is no light task, for the material is so tough that the tools will not stand hard driving; but in spite of this handicap, the operator completes four of these valve cages—28 holes, bored, reamed and finish reamed—per nine-hour day, thanks to the power and rigidity of the Colburn Drill.

The above operation is typical of the service this machine has performed for over three years for the National Transit Pump & Machine Company, Oil City, Pa., typical also of the efficiency with which all Colburn Machines—Vertical Boring and Turning Mills as well as Drill Presses—handle difficult and exacting operations on a wide variety of work.

Let us tell you more about them.

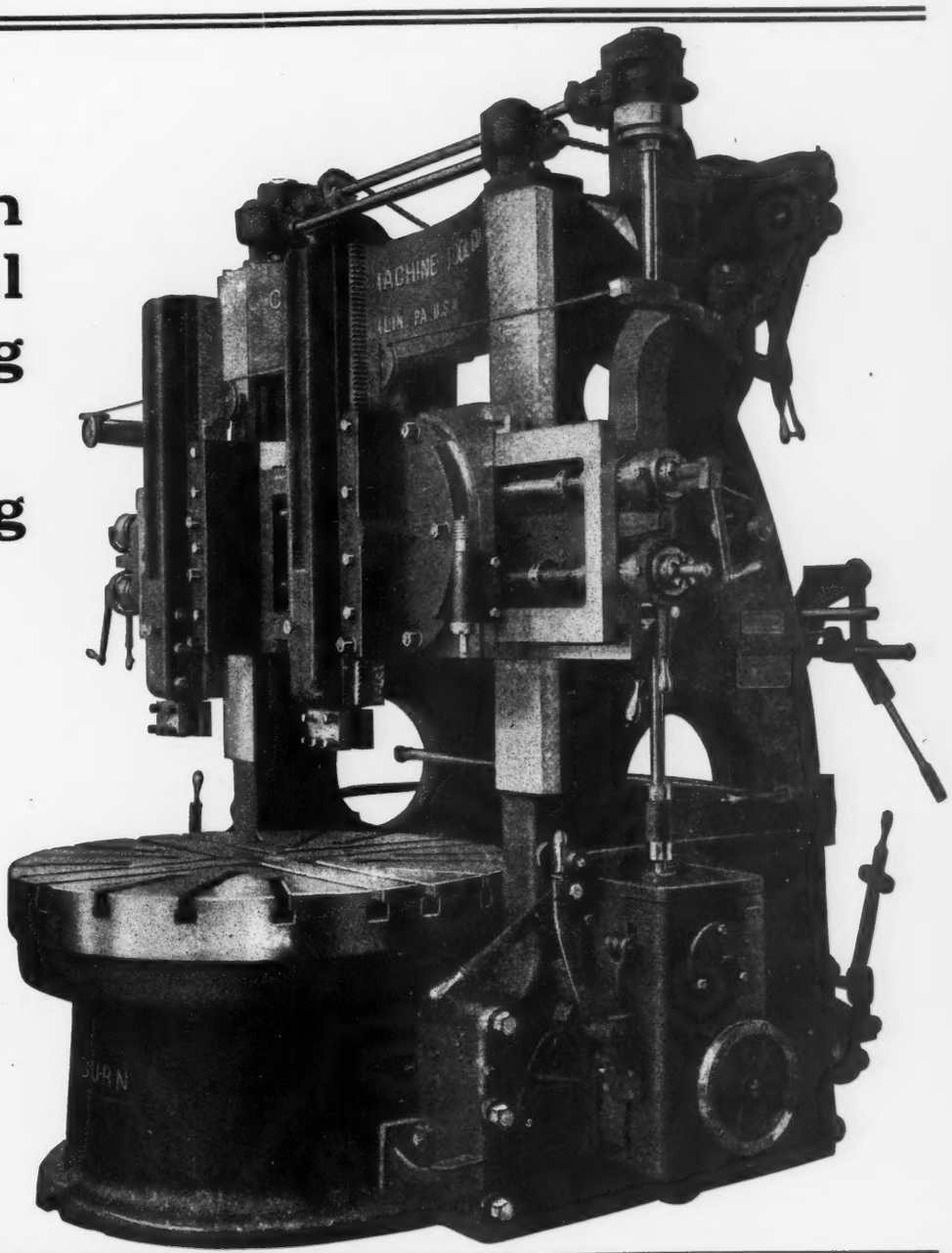
COLBURN MACHINE TOOL

DOMESTIC AGENTS: Henry Prentiss & Co., Inc., New York, Boston, Hartford, Conn., Buffalo, Rochester, Syracuse, N. Y., Scranton, Pa.; Strong, Carlisle & Hammond, Cleveland and Detroit; Brown & Zortman Mach. Co., Pittsburgh; Sherritt & Stoer Co., Philadelphia; Dale Brewster Co., Chicago; Northern Machinery Co., Minneapolis and Duluth; Seifreat-Woodruff Co., Cincinnati and Dayton, Ohio; Berger & Carter, San Francisco and Los Angeles, Cal.; Hallidie Machinery Co., Seattle, Wash.; Young & Vann Supply Co., Birmingham, Ala.; C. T. Patterson Mach. Co., New Orleans, La.; Ralph B. Bowman, St. Louis, Mo., Mills & Lupton, Chattanooga, Tenn.; Fulton Supply Co., Atlanta, Ga.; Marshall & Huschart Mchy. Co., Indianapolis, Ind. (Drill Presses only). CANADIAN AGENTS: H. W. Petrie, Toronto, Ont.; Rudel Belnap Mchy. Co., Montreal, Que. FOREIGN AGENTS: Fenwick Freres, France, Switzerland, Italy; E. Isbecque & Co., Belgium; American Machinery Syndicate, Spain and Portugal; Charles Churchill & Co. (Boring Mills only), England; Alfred Herbert, Ltd. (Drill Presses only), England, Australia, Japan, India.

L B U R N

Heavy Duty Drill Presses and Vertical Boring and Turning Mills

Colburn Vertical Boring and Turning Mill

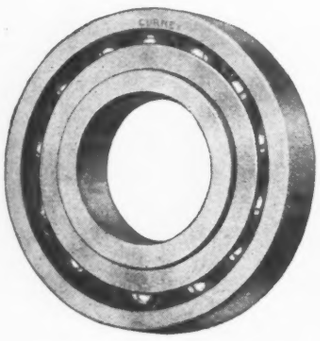


Machines with the capacity to take fine, finishing cuts with a high degree of accuracy and heavy, roughing cuts without chatter.

Machines with a reputation for power, speed and operating convenience coupled with a range of adaptability well worth investigating.

COMPANY, Franklin, Pa., U.S.A.

DOMESTIC AGENTS: Henry Prentiss & Co., Inc., New York, Boston, Hartford, Conn., Buffalo, Rochester, Syracuse, N. Y., Scranton, Pa.; Strong, Carlisle & Hammond, Cleveland and Detroit; Brown & Zortman Mach. Co., Pittsburgh; Sherritt & Stoer Co., Philadelphia; Dale Brewster Co., Chicago; Northern Machinery Co., Minneapolis and Duluth; Seifreat-Woodruff Co., Cincinnati and Dayton, Ohio; Berger & Carter, San Francisco and Los Angeles, Cal.; Hallidie Machinery Co., Seattle, Wash.; Young & Vann Supply Co., Birmingham, Ala.; C. T. Patterson Mach. Co., New Orleans, La.; Ralph B. Bowman, St. Louis, Mo., Mills & Lupton, Chattanooga, Tenn.; Fulton Supply Co., Atlanta, Ga.; Marshall & Huschart Mchy. Co., Indianapolis, Ind. (Drill Presses only). CANADIAN AGENTS: H. W. Petrie, Toronto, Ont.; Rudel Belnap Mchy. Co., Montreal, Que. FOREIGN AGENTS: Fenwick Freres, France, Switzerland, Italy; E. Isbecque & Co., Belgium; American Machinery Syndicate, Spain and Portugal; Charles Churchill & Co. (Boring Mills only), England; Alfred Herbert, Ltd. (Drill Presses only), England, Australia, Japan, India.



The Area Contact in Gurney Bearings

A ball in a Gurney Ball Bearing does NOT have "Point contact."

Because the contour of the Gurney races very closely approaches that of the balls, and because all balls are slightly compressed under load, a larger portion of their circumference coincides with the contour of the race-ways. Thus the spots of contact are of quite an appreciable area, and increase at a rapid rate with increased load.

In fact, in some Gurney Bearings, each ball is capable of carrying as much load with safety as 26 balls of this same size rolling between two plane surfaces.

The Gurney Idea of "area of contact," together with the Gurney Method of assembling which permits maximum size and number of balls, accounts for the greater load capacity of Gurney Ball Bearings.

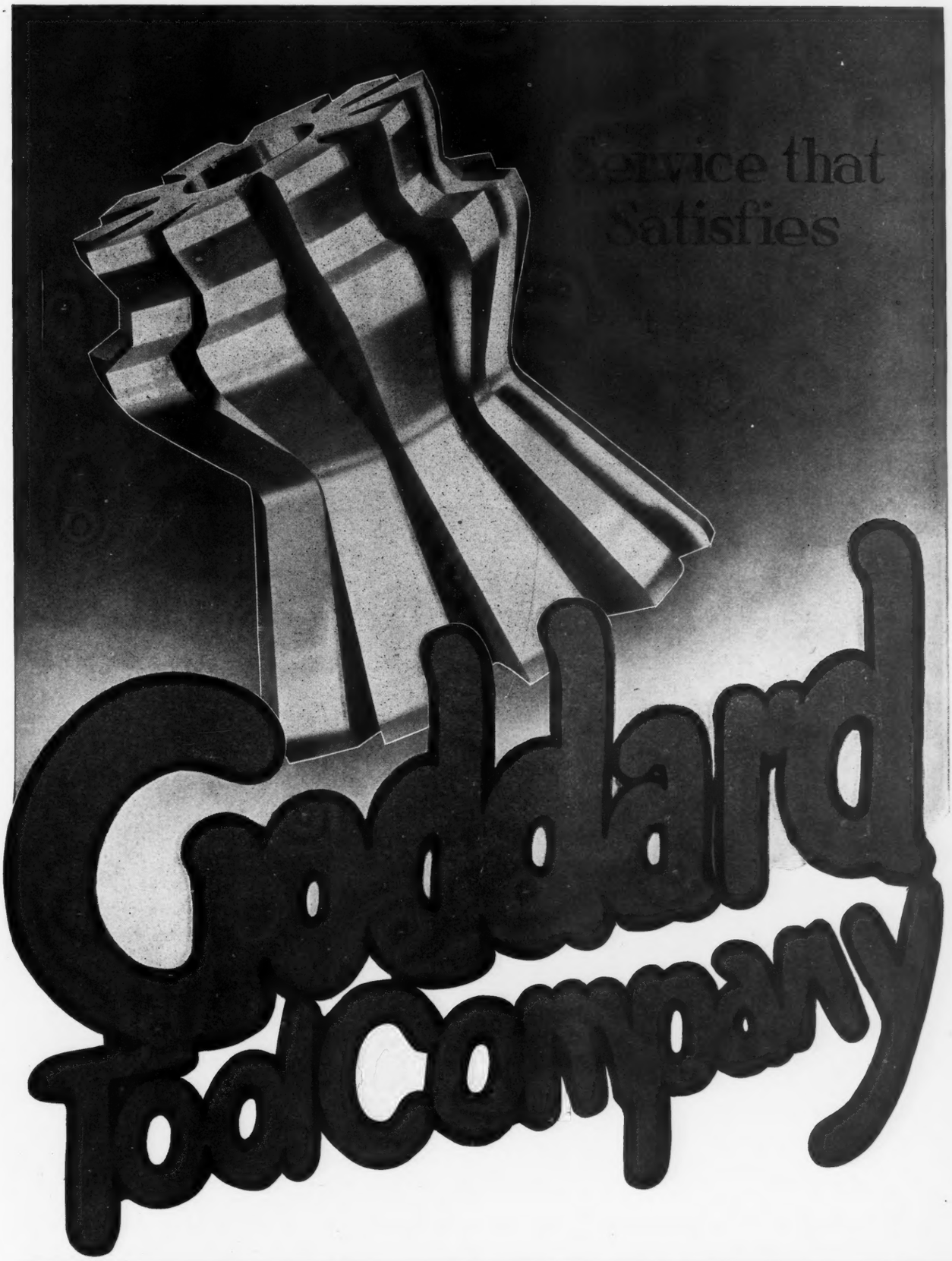
GURNEY BALL BEARING COMPANY

Conrad Patent Licensee

Jamestown, N. Y.

GURNEY

BALL BEARINGS



GODDARD TOOL COMPANY

PLANT **Chicago** PLANT **Detroit**

Branch Offices

Philadelphia Bourse, Philadelphia—404 Mutual Home Bldg., Dayton, Ohio

Stock of Standard Cutters and Hobs Carried at Both Branch Offices

CARD



Taps of Uniform Quality for All Purposes

The CARD Quality

Everyone has his preferences and his own reasons for them. The machinist prefers Card Taps because they make his work easier and better; the foreman requisitions them because they enable him to "get production"; and the boss endorses them because they insure interchangeability to his threaded parts—at a handsome profit.

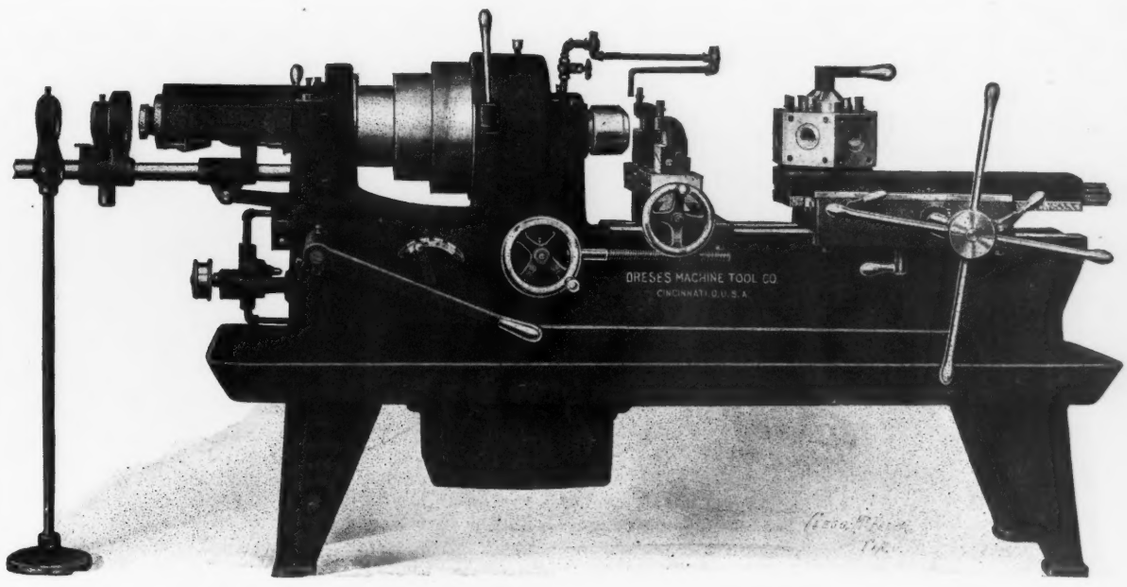
Standard for 46 years. Catalog 29 lists full line.

S. W. CARD MANUFACTURING COMPANY

Division of Union Twist Drill Co.

NEW YORK OFFICE, 62 READE ST. **MANSFIELD, MASS., U. S. A.**

EUROPEAN AGENTS: Chas. Churchill & Co., London, Birmingham, Manchester, Glasgow and Newcastle-on-Tyne. Markt & Co., Ltd., Paris. V. Lowener, Vesterbrogade 9 B, Copenhagen, Denmark. V. Lowener, Drottinggattan 90, Stockholm, Sweden. V. Lowener's Maskinforretning, Sverre Mohn, Christiania, Norway. R. S. Stokvis & Zonen, Ltd., Rotterdam. J. Lambercier & Co., Geneva. C. Civita, Milano, Italy. R. D'Aulignac, Barcelona, Spain. Ateliers Demoor, Brussels, Belgium. A. M. Papasideris & Co., Athens, Greece. Andersen, Meyer & Co., Ltd., Shanghai, Changsha, Hankow, Harbin, Hongkong, Kalgan, Pekin, Tientsin, and Vladivostock. Mestre & Blatge, Rio de Janeiro, Brazil; Buenos Aires, Argentine Republic.

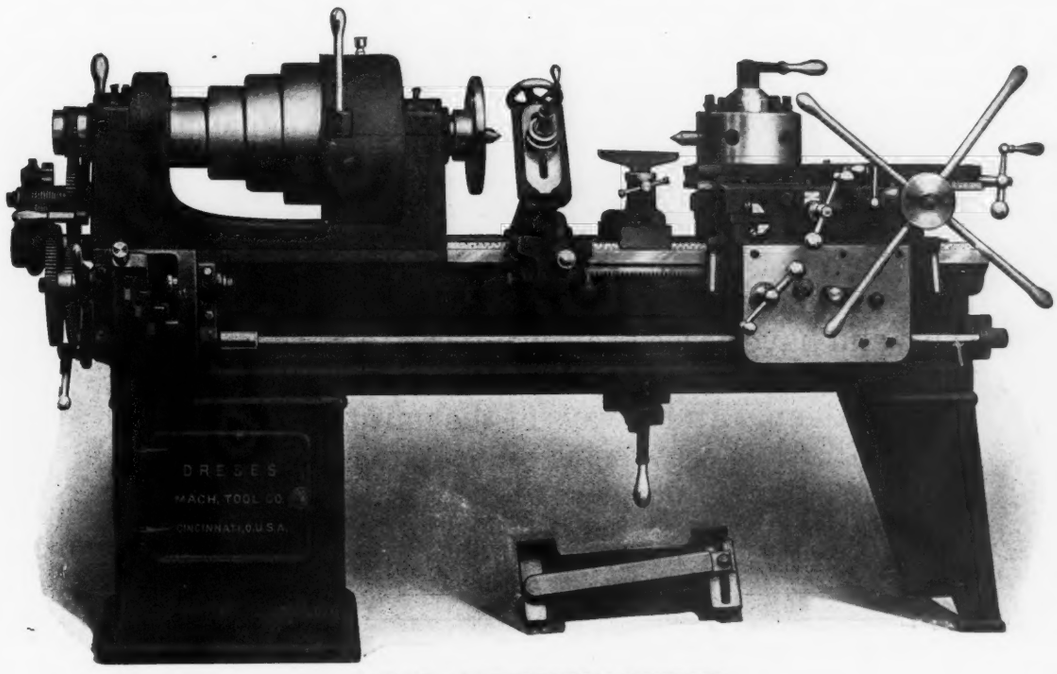


1", 1½" and 2¼" SCREW MACHINES

DESIGN and QUALITY

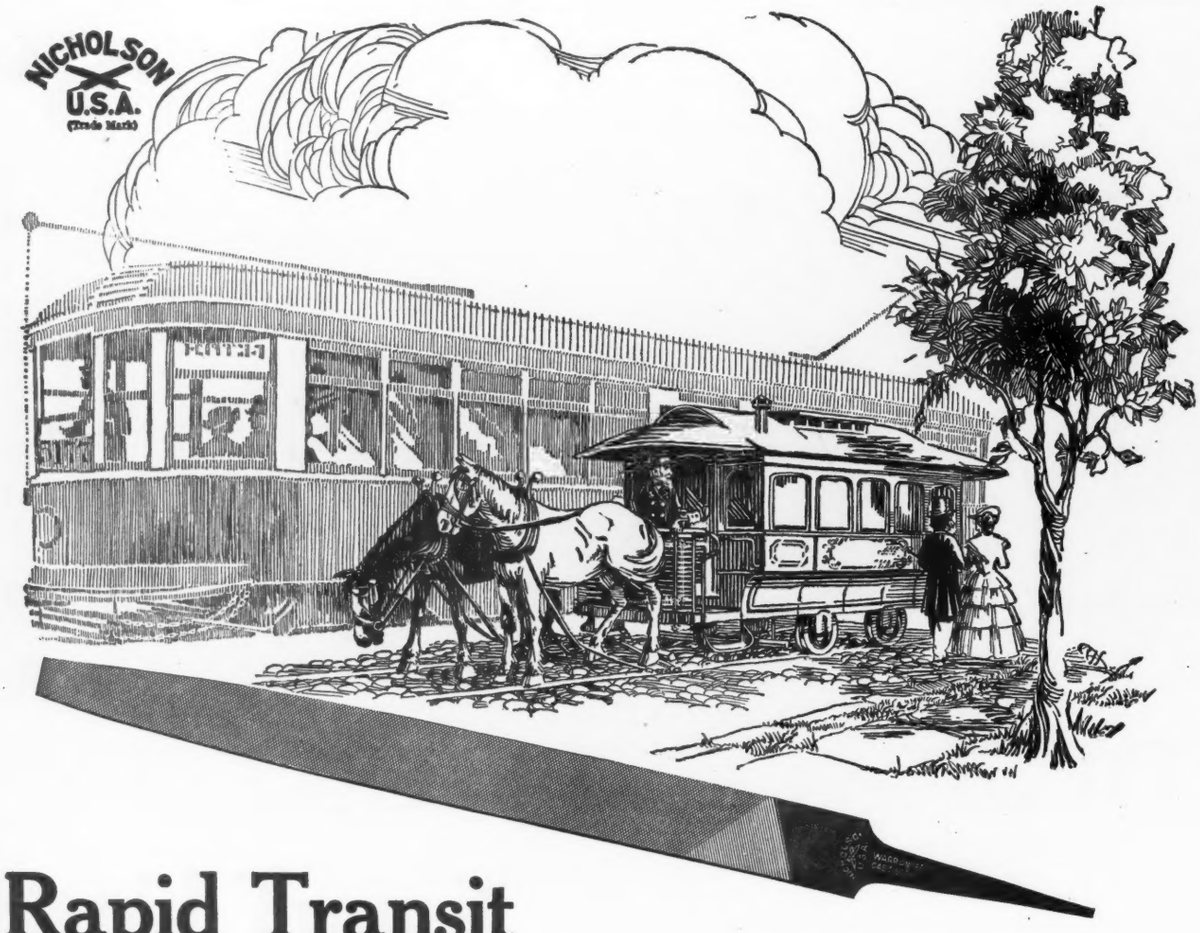
Distinguish our complete line of

SCREW and TURRET MACHINERY



15" 18" and 20" UNIVERSAL MONITORS

DRESES MACHINE TOOL CO., Cincinnati, Ohio



Rapid Transit

A great mechanical industry of itself, yet multiplied in importance in the industrial world because it enables the strategical concentrations of workers that are essential to today's production in unprecedented volume.

NICHOLSON FILES

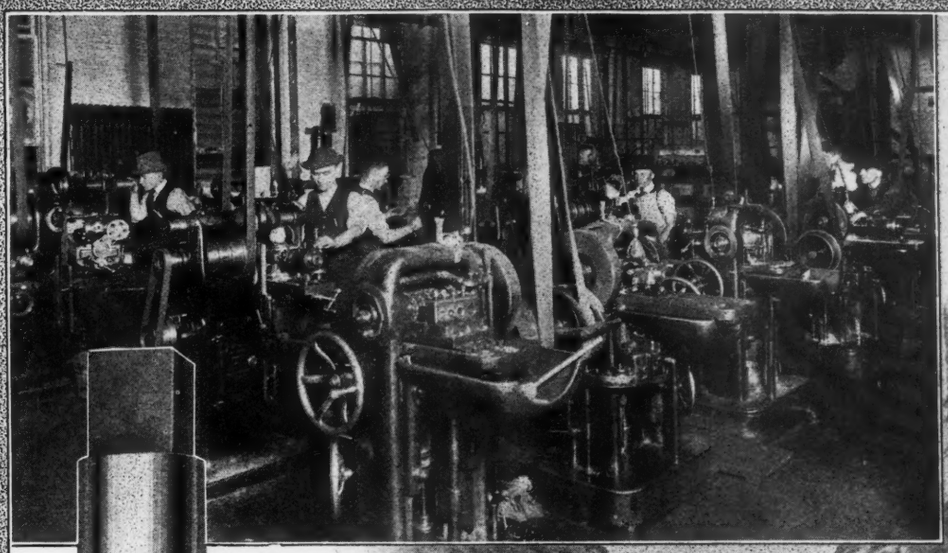
have kept apace with the manufacturing developments that have built up modern interurban and street railways and have served faithfully in car building and repairing plants. Day by day, year by year, better files, more of them. And always of the uniformity of cutting quality that has won them staunch friends among those who know and value good files.



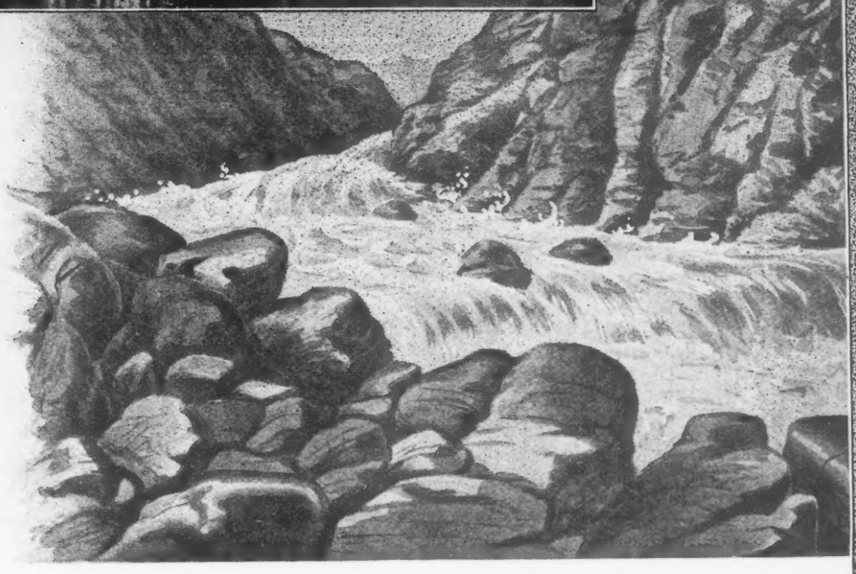
Write for our Catalog and for File Filosophy—a most instructive booklet about files and their use.

NICHOLSON FILE CO.

PROVIDENCE, R.I., U.S.A.



MILLING DEPT.





Flutes and Production

The depth and the width of the flute and its angle determine a tool's production value. The flutes in Ampco reamers are milled unusually deep without sacrificing, in the slightest degree, toughness and endurance.

Deep flutes mean more holes reamed per tool.

Ampco reamers last longer—and they always guarantee a re-order.

If you have not tried Ampco reamers order some and get all the holes from a reamer that you should.

Because we specialize we always carry a complete stock of standard sizes—3- and 4-lip drills, reamers, cutters and end mills.

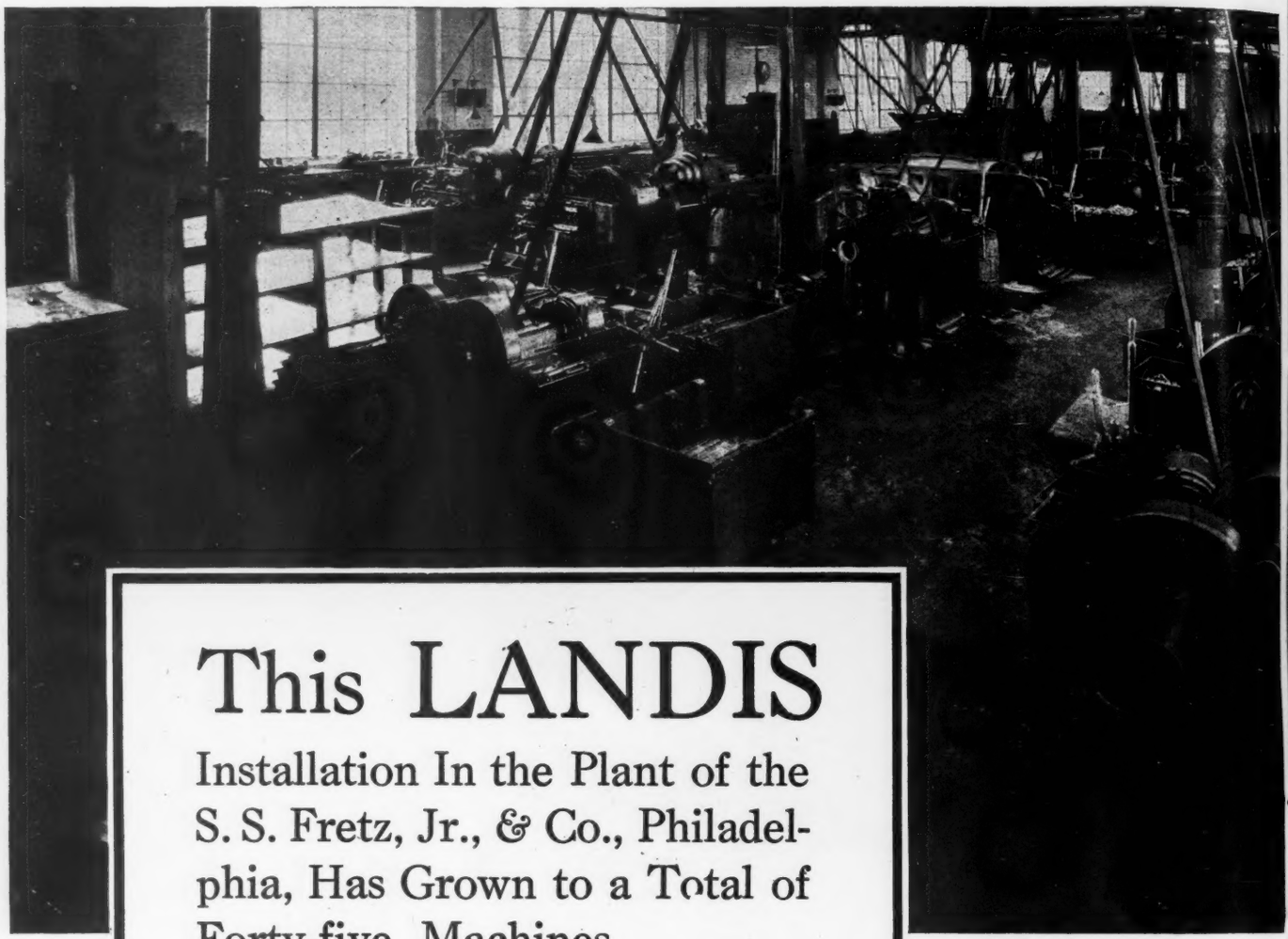
Ampco means Endurance and Accuracy.

AMERICAN MACHINE PRODUCTS CO.
DETROIT

Cleveland Office:
716 Superior Ave., N. W.

Canadian Plant:
Ingersoll Machine Co., Ingersoll, Ont.

Chicago Office:
524 Madison Terminal Bldg., 9 South Clinton St.

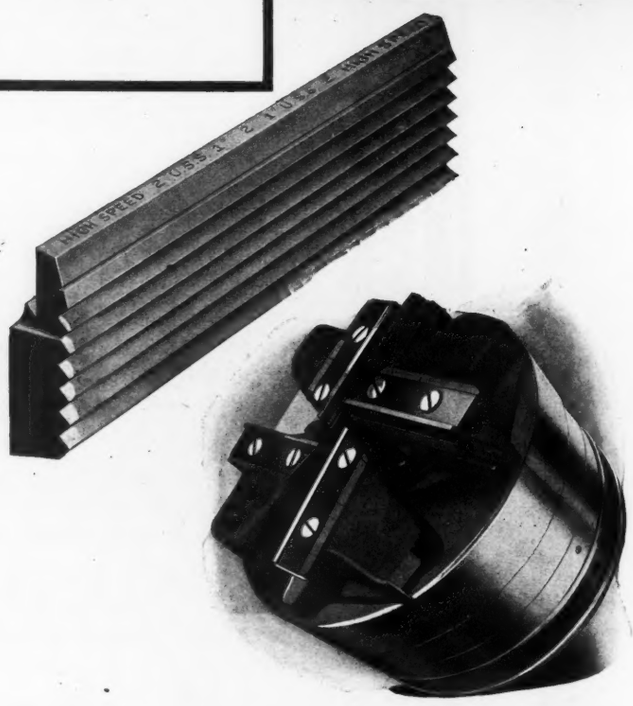


This LANDIS

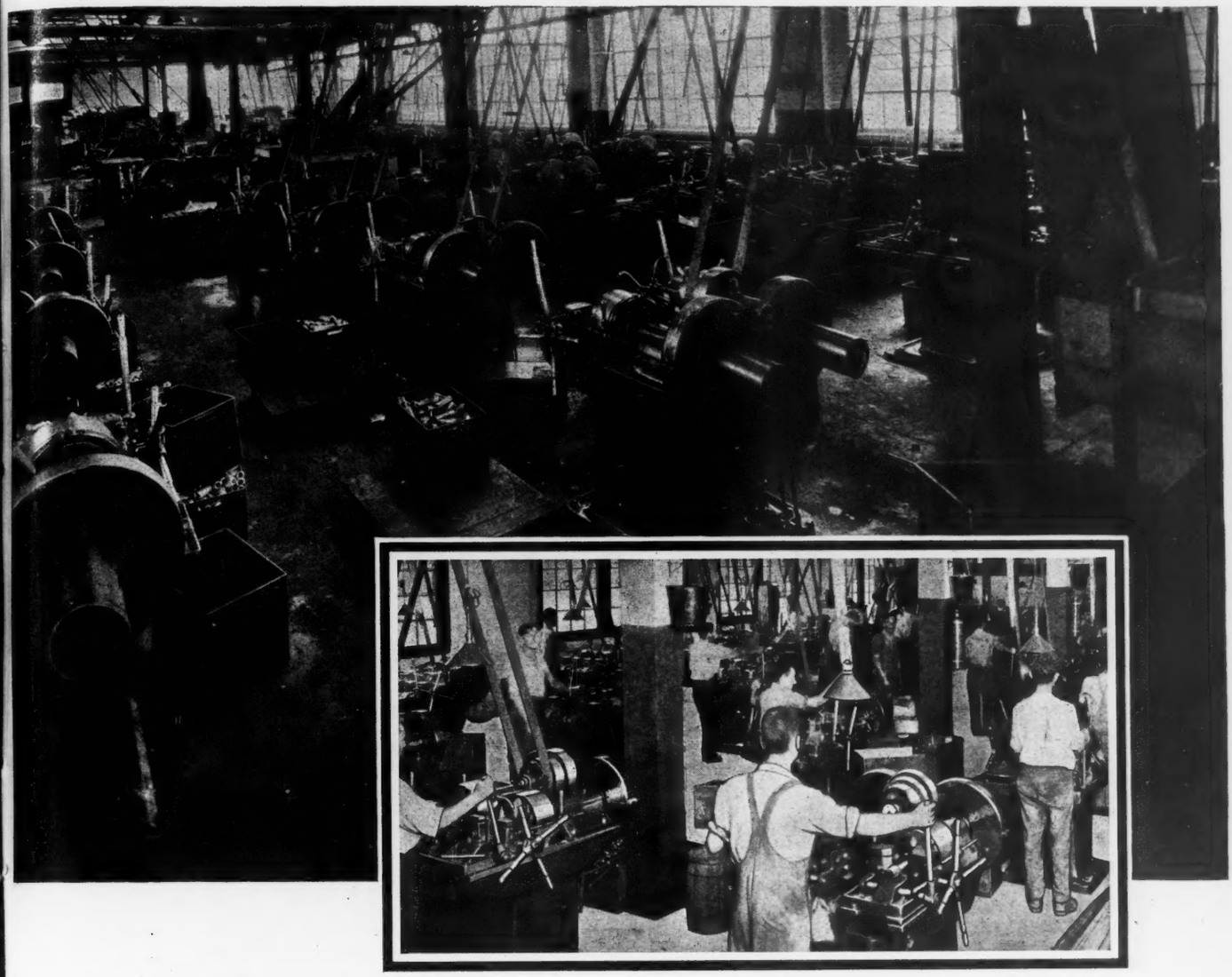
Installation In the Plant of the S. S. Fretz, Jr., & Co., Philadelphia, Has Grown to a Total of Forty-five Machines.

A period of four years separates these two installation photographs, both taken in the plant of S. S. Fretz, Jr., & Co., Philadelphia, Pa. The smaller one shows this company's Landis installation as it was in 1916—the larger as it is today; twenty-six and forty-five machines respectively.

Since this company ordered its first two Landis Threading Machines in 1914 its growth has been enormous and its Landis installation correspondingly great.



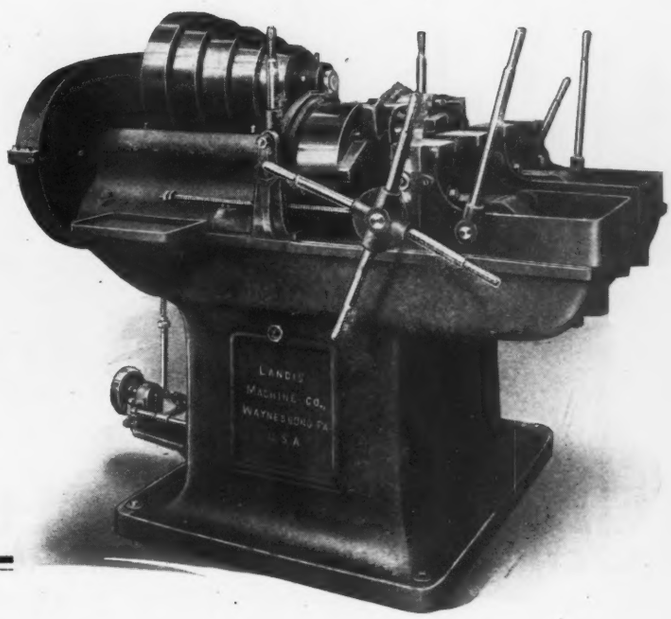
LANDIS MACHINE COMPANY, Inc.,



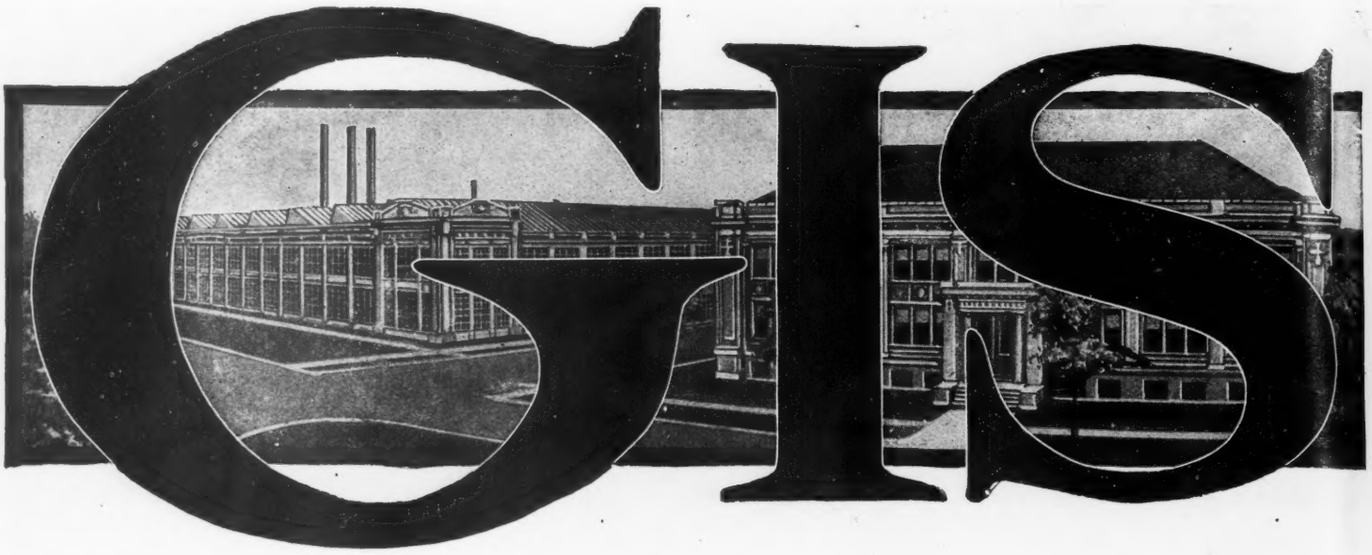
Landis Threading Machines are used by many concerns, large and small, as standard threading equipment. They have many distinctive features which make for ease of operation, accuracy of product and economy in bulk production.

Remember that Landis Threading Machines will cut both right- and left-hand threads from the same chasers by simply using right- or left-hand holders; and there's no hobbing, re-tempering, etc.

We shall be glad to give you full particulars of Landis Threading Machines, and to advise you regarding choice of threading equipment for your own particular problems. Write.



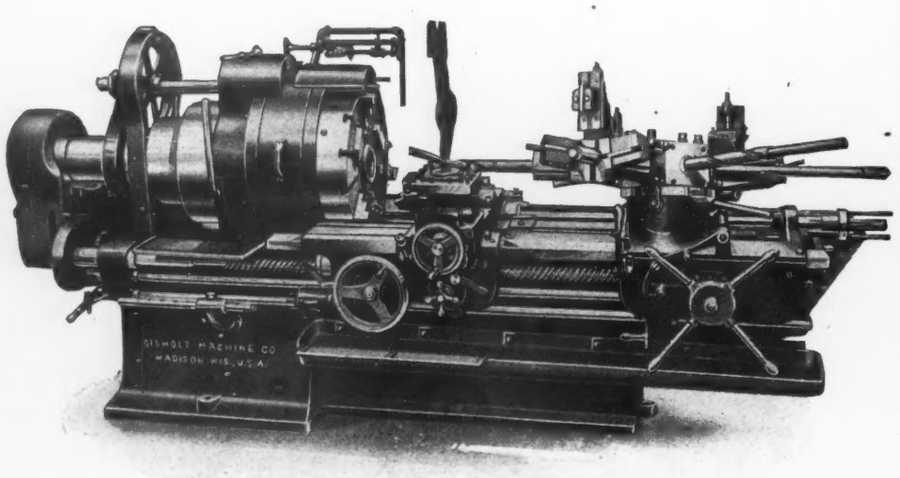
Waynesboro, Pa., U. S. A.



Some Gisholt Turret Lathe Advantages

Get this! Gisholt Standard Turret Lathes are high production machines, but because they are, it does not follow that large quantities of the same piece must be produced in order to make the Gisholt a paying investment. You can set up the Gisholt turret lathe and produce three or four pieces in the identical time required for turning out the same number of pieces by the single tool method. And once the Gisholt is set up, its multiple cutting tools and automatic stops make it possible to turn out the work fast and accurately. Study these economic advantages:—

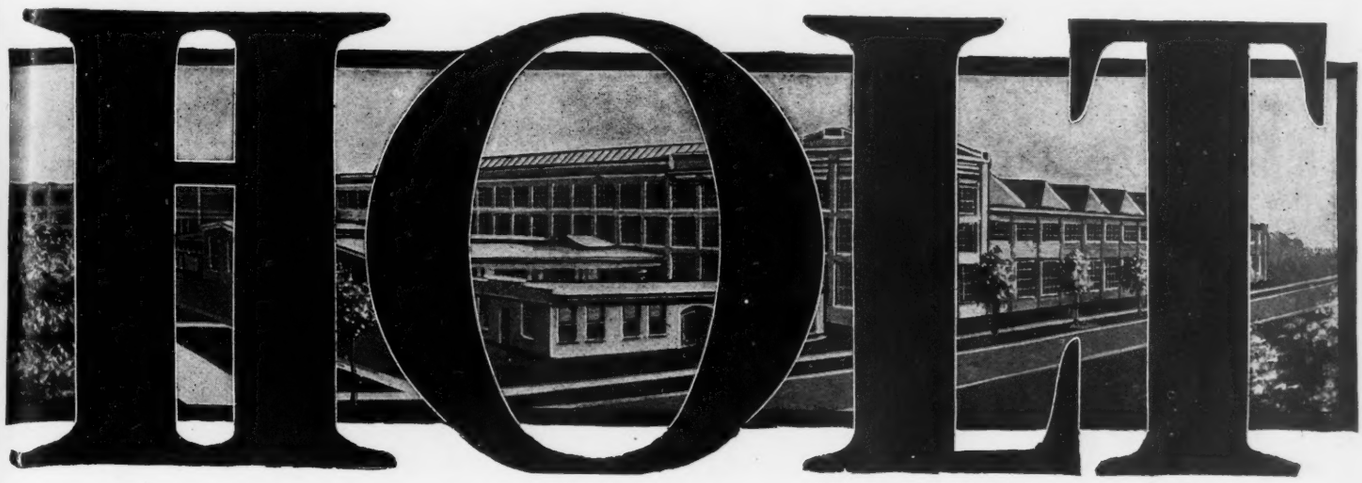
1. More work can be produced with the same amount of labor and floor space than is possible with machines using single tools. 2. Work will be more accurate, more nearly duplicate and will flow in a faster stream through the machine shop. 3. Quicker delivery of finished parts to your assembly floor, and in larger lots. 4. In addition to producing more parts of a kind at a time, in the machine shop, the work will be greatly simplified, as less fitting is required on the assembly floor, due to more accurately machined parts. 5. More economical routing of work, permitting of earlier shipments and making it easier to keep delivery promises.



GISHOLT MACHINE COMPANY

30 CHURCH STREET *Eastern Sales Office:* **NEW YORK CITY**

AGENTS: Atlanta, Ga., Seeger Machine Tool Co.; Buffalo, N. Y., J. L. Osgood; Chattanooga, Tenn., James Supply Co.; Chicago, Ill., Stocker-Rumely-Wachs Co.; Denver, Colo., Hendrie & Bolthoff Mfg. & Supply Co.; Detroit, Mich., Chas. A. Sterlinger Co.; Indianapolis, Ind., Vonnegut Machinery Co.; Los Angeles, Cal., Smith-Booth-Usher Co.; New Orleans, La., P. H. McArdle; Philadelphia, Pa., Swind Machinery Co.; Portland, Ore., Portland Machinery Co.; St. Louis, Mo., Colcord-Wright Mchy. & Supply Co.; Minneapolis, St. Paul, Minn., Savage & Winter Co.; Salt Lake City, Utah, Salt Lake City Hdwe. Co.; San Francisco, Cal., F. O. Supply Co.; Seattle, Wash., Perine Machinery Co. CANADA: Canadian Fairbanks-Morse Co., Calgary, Hamilton, Montreal, Ottawa, Quebec, St. John, Toronto, Vancouver, Winnipeg.



Let a Boy Grind the Tools

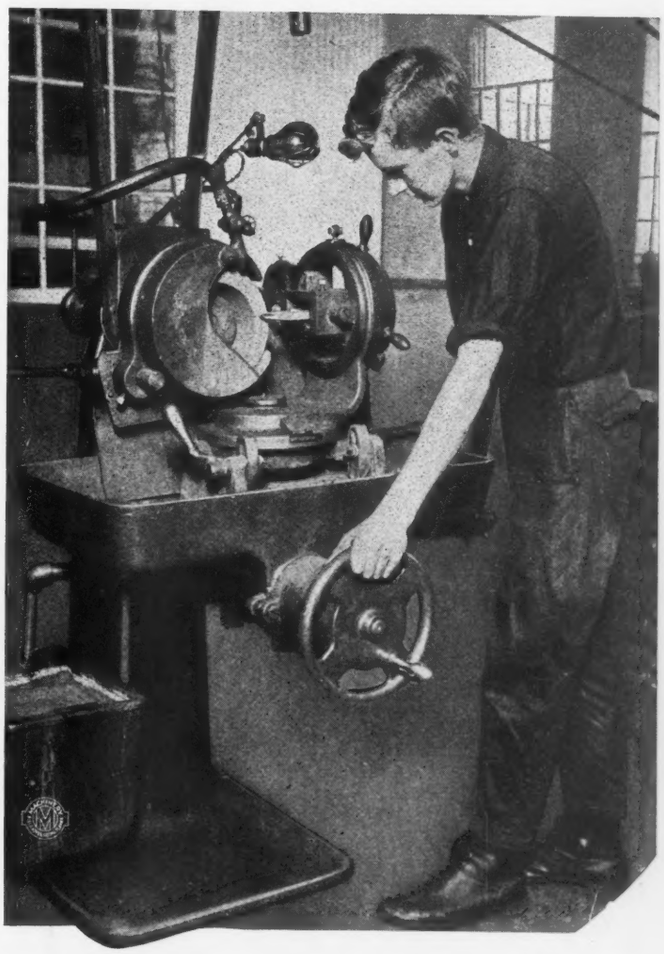
A boy can grind all the tools for your plant, and grind them better than your skilled mechanic can do it by hand, if you will install a *Gisholt Tool Grinder.*

Why permit your men to waste time, their time and yours, at the old style tool grinder? Install a *Gisholt Tool Grinder* and you will do away with the present unnecessary and frequent interruptions in production.

With the Gisholt, a boy can grind your tools quickly and accurately, and without waste of stock, time or effort. With this grinder he can satisfactorily take care of all your lathe, planer, shaper, slotter, turret lathe, automatic, or boring mill tools.

There is no reason in the world for dull tools—dull tools mean inefficient machines. Every machine in your plant should have its properly ground quota of tools ready for instant use the moment they are needed.

Ask a Gisholt representative to tell you more about these interesting cost-cutting machines.



GISHOLT MACHINE COMPANY

General Offices: 9 S. Baldwin St., Madison, Wisconsin
Works: Madison, Wisconsin; Warren, Pennsylvania

FOREIGN AGENTS: Australia, Benson Bros., Sydney, Melbourne; Belgium, Ateliers Demoor, Brussels; British Isles, Burton, Griffiths & Co., London, Birmingham, Manchester and Glasgow, Scotland; France, Aux Forges de Vulcain, Paris; Italy, Emanuele Mashcherpa, Milan; Japan, Andrews & George, Tokyo; Norway, Union Machine Co., Christiania; Sweden, Axel Ryden, Stockholm; Switzerland, J. Lambercier & Co., Geneva.

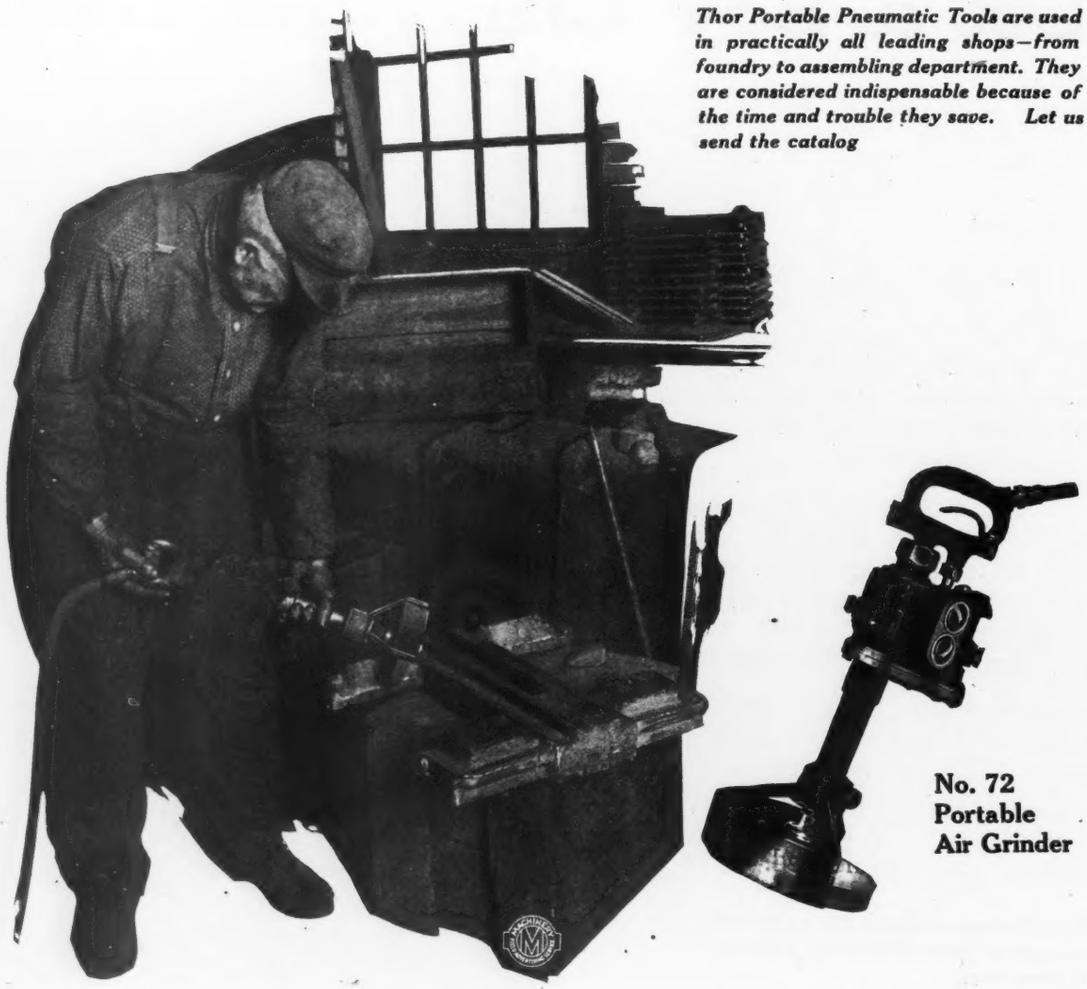
Thor Pneumatic Grinder

Six Years Without Hint of Trouble

In the big lathe manufactory where this picture was taken, they believe that all castings, large and small, must have a thorough snagging to make them suitable as a foundation on which to build fine, accurate machines.

In this connection the Thor No. 72 Portable Pneumatic Grinder here shown has been an important factor for more than six years, being used on a variety of parts. It has never balked or required any attention other than occasional cleaning and overhauling.

Thor Portable Pneumatic Tools are used in practically all leading shops—from foundry to assembling department. They are considered indispensable because of the time and trouble they save. Let us send the catalog

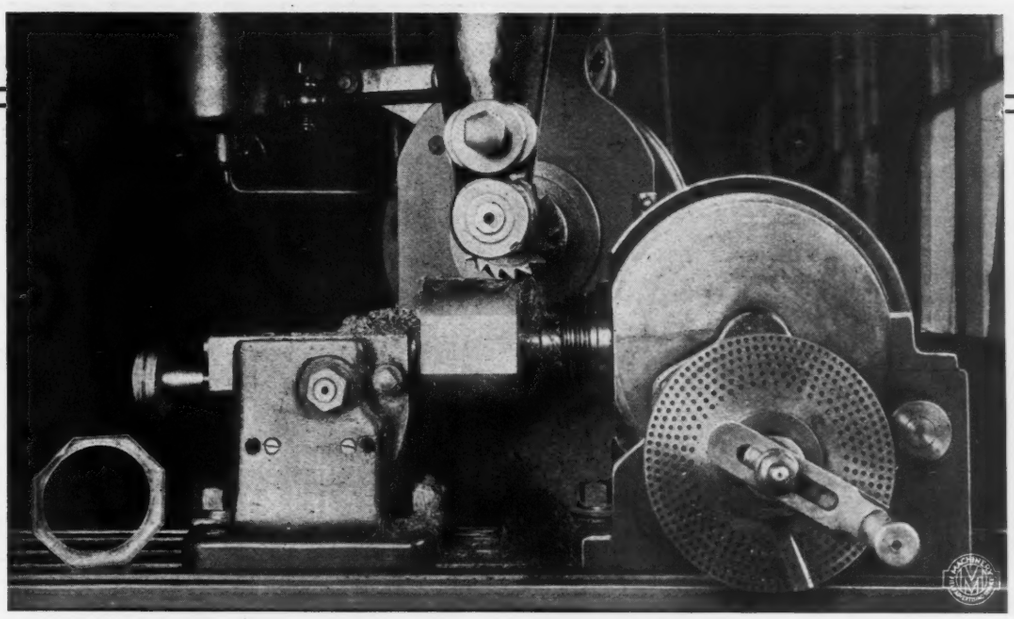


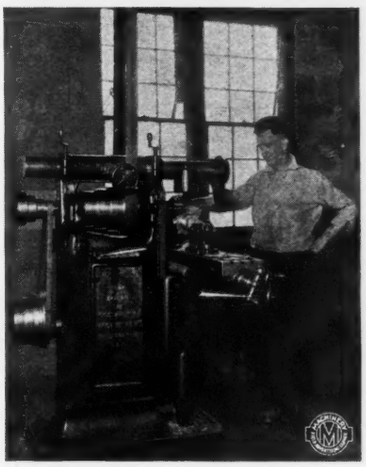
No. 72 Portable Air Grinder

INDEPENDENT PNEUMATIC TOOL COMPANY

Branch Offices:

Chicago New York Philadelphia Boston St. Louis Detroit
Pittsburgh Cleveland San Francisco Birmingham Montreal Toronto



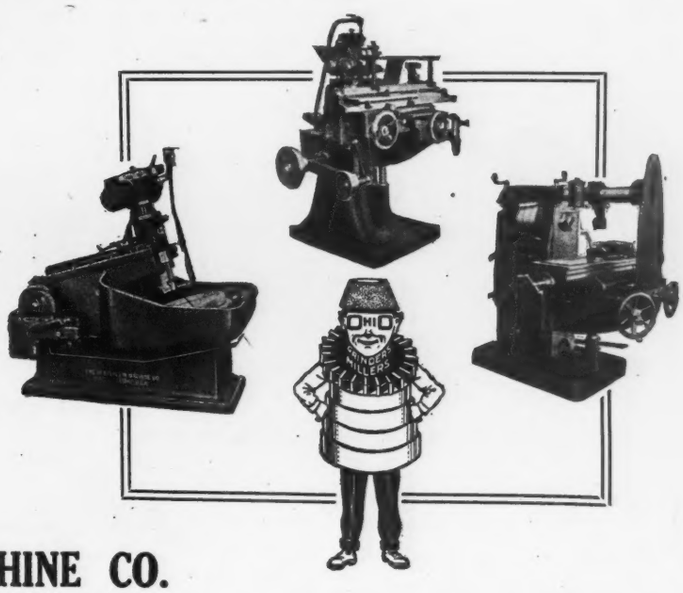


This Ohio Miller

Is "Accurate and Dependable"

So they say at the Valley Machine Works, Connersville, Indiana, where they have used the machine shown continuously for more than two years in manufacturing dies and tools. When photographed it was being used in making a tool-steel punch for an automobile tail-lamp door.

The door—shown at the extreme left of upper photo—is made of 20 gage brass and is 3⅜" across inside. The octagonal punch must, of course, be accurately indexed, so they use the Ohio Dividing Head—one of the many practical Ohio attachments described in the story of Ohio "Specialized Construction" furnished on request.



THE OESTERLEIN MACHINE CO.

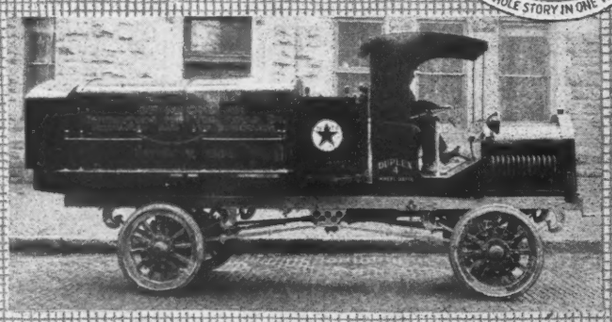
CINCINNATI OHIO, U. S. A.

MILLERS **OHIO** GRINDERS

Tools in Which Every Ounce Works

O. S. Terlein says: "I don't suppose there is any part of an automobile that one or another of the 'Ohio Trio' doesn't have a hand in making somewhere along the line."

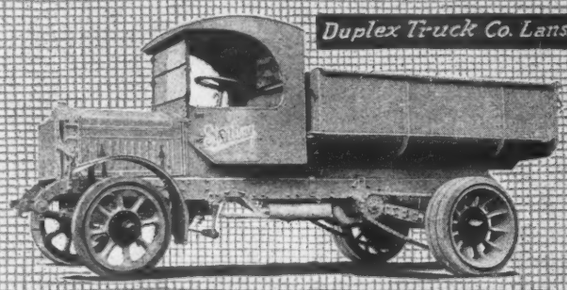
MULTI-DRILLERS NATCO MULTI-TAPPERS
THE HOLE STORY IN ONE WORD

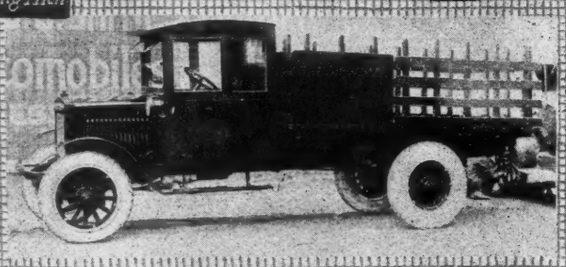




Duplex Truck Co. Lansing Mich

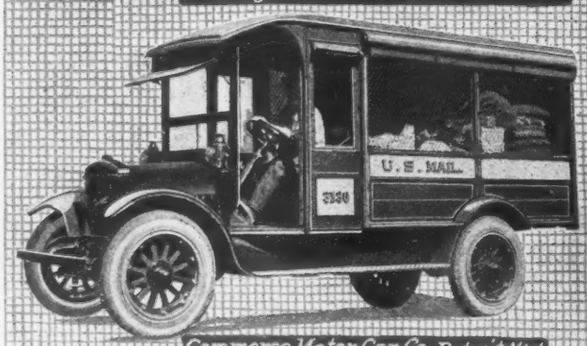
The Autocar Company Ardmore Pa.

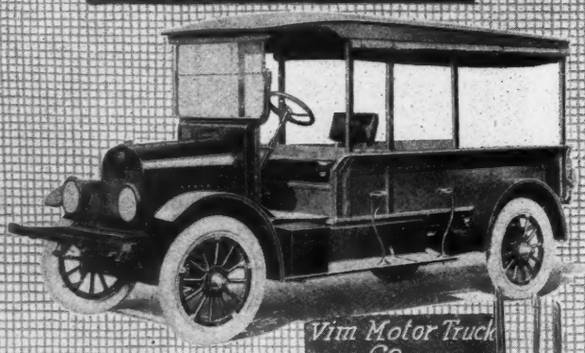




Sterling Motor Truck Co. Milwaukee Wis.

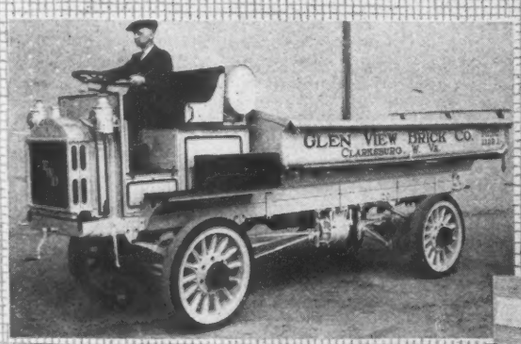
Kissel Motor Car Co. Hartford, Wis.





Commerce Motor Car Co. Detroit Mich.

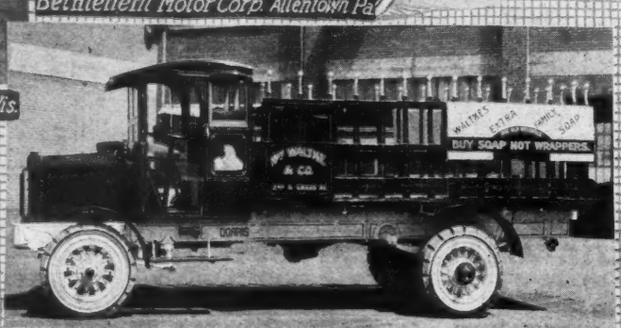
Vim Motor Truck Co. Philadelphia Pa.





Bethlehem Motor Corp. Allentown Pa.

The Four Wheel Drive Auto Co. Clintonville Wis.



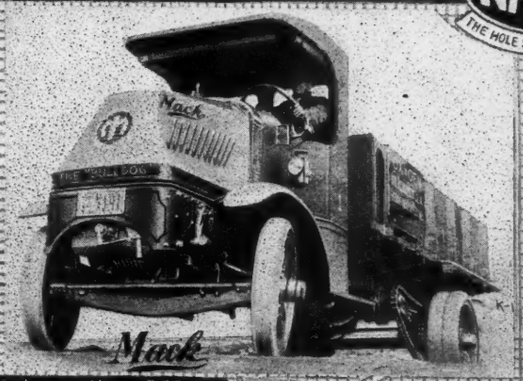
Dorris Motor Car Co. St. Louis Mo.

NATCO Multi-Drillers and Multi-Tappers have served most economically and efficiently in the manufacture of these popular motor trucks.

The NATIONAL AUTOMATIC TOOL CO., Richmond, Ind., U.S.A.

MULTI-DRILLERS NATCO MULTI-TAPPERS

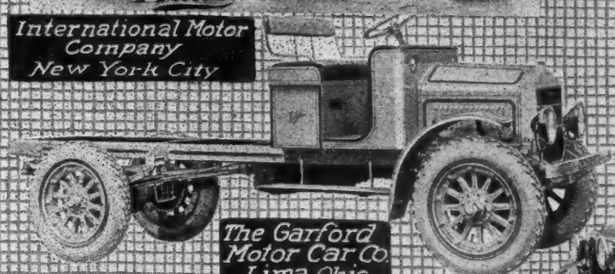
THE HOLE STORY IN ONE WORD



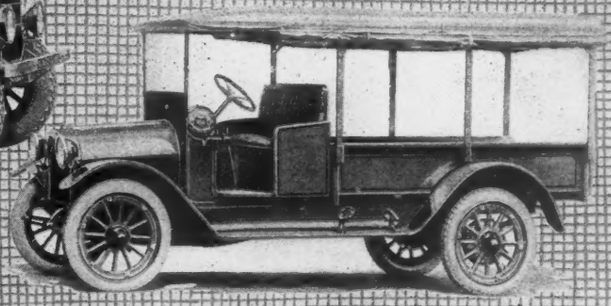
International Motor Company New York City

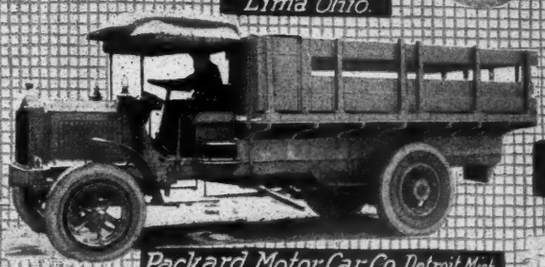


International Harvester Company Chicago Illinois



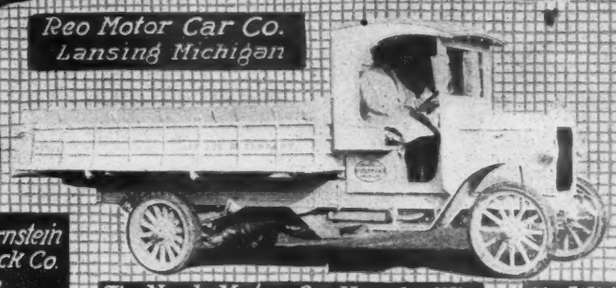
The Garford Motor Car Co. Lima Ohio.

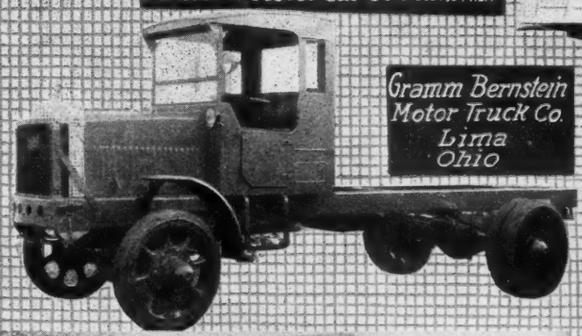




Reo Motor Car Co. Lansing Michigan

Packard Motor Car Co Detroit Mich

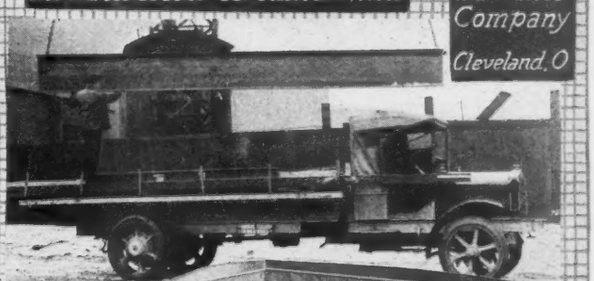




Gramm Bernstein Motor Truck Co. Lima Ohio

The Nash Motor Co. Kenosha Wis.

The White Company Cleveland, O





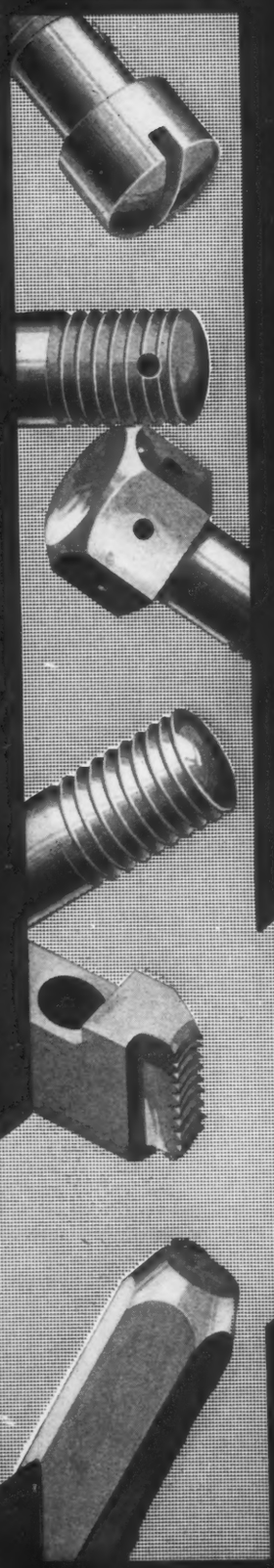


General Motors Corporation Pontiac Mich.

Republic Motor Truck Co. Alma, Mich.

The NATIONAL AUTOMATIC TOOL CO., Richmond, Ind., U.S.A.

NAMCO



& STUD
READING

CHASER & TOOL
GRINDING

BAR POINTI

AUXILIARY MACHINES

For Secondary Operations—

NAMCO Auxiliary Screw Making Machines were built originally to meet most economically the requirements of our own screw products business. Therefore they represent, both in design and construction, the most efficient method of handling work within their respective uses and capacities as follows:

SEMI-AUTOMATIC SCREW SLOTTERS—

For slotting all kinds of screw heads, regular or irregular, and for milling operations on special parts. Capacity up to ¾".

SEMI-AUTOMATIC M. S. DRILLER—

For drilling holes in screws, bolts and irregular pieces—6 at a time. Feeding, cutting and extracting operations are simultaneous. Capacity up to ¾".

TWO-SPINDLE BOLT THREADER—

For the rapid threading of blanks, milled, upset or forged. Capacity up to ¾".

AUTOMATIC STUD THREADER—

For the automatic threading of studs. Capacity up to 1".

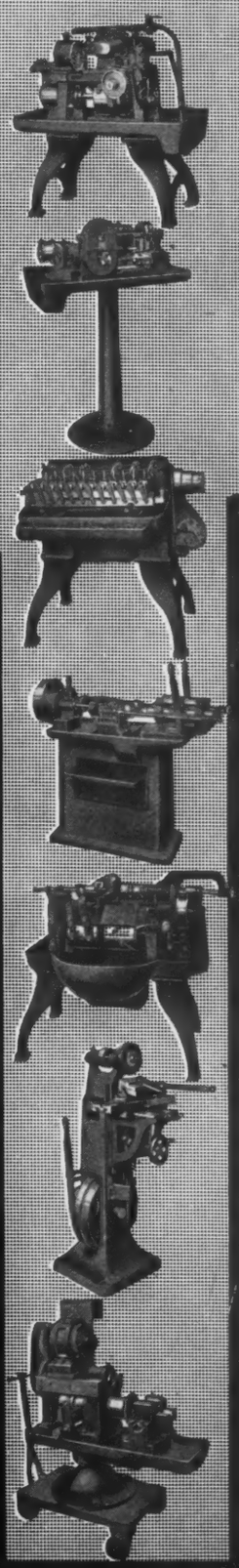
TOOL GRINDER—

For grinding tools in general machine shop practice.

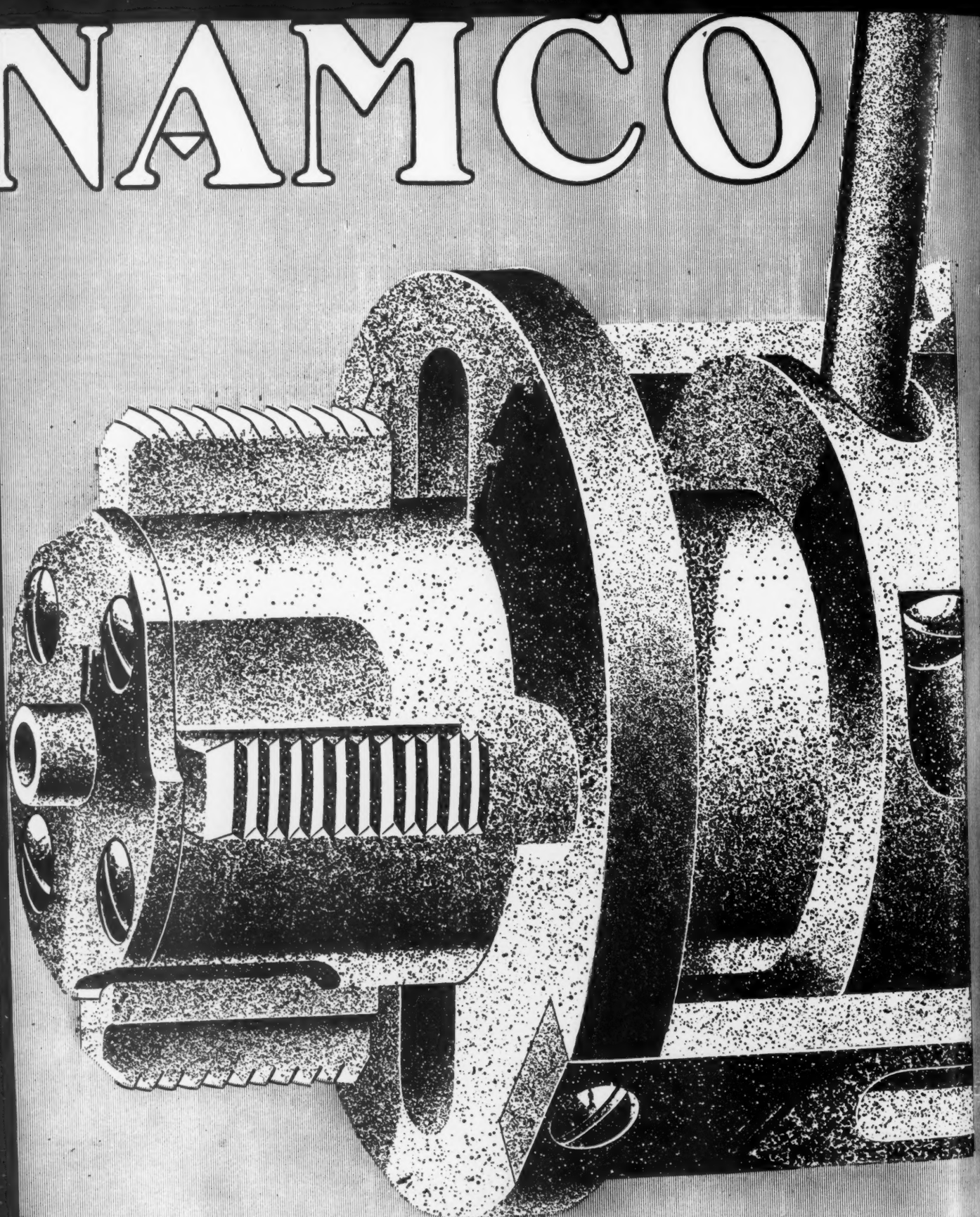
BAR POINTER—

For preparing bar stock for automatic machines.

Our new catalog—A. S. M. M.—gives a detailed description, suitably illustrated, of each machine. Let us furnish you a copy



NAMCO

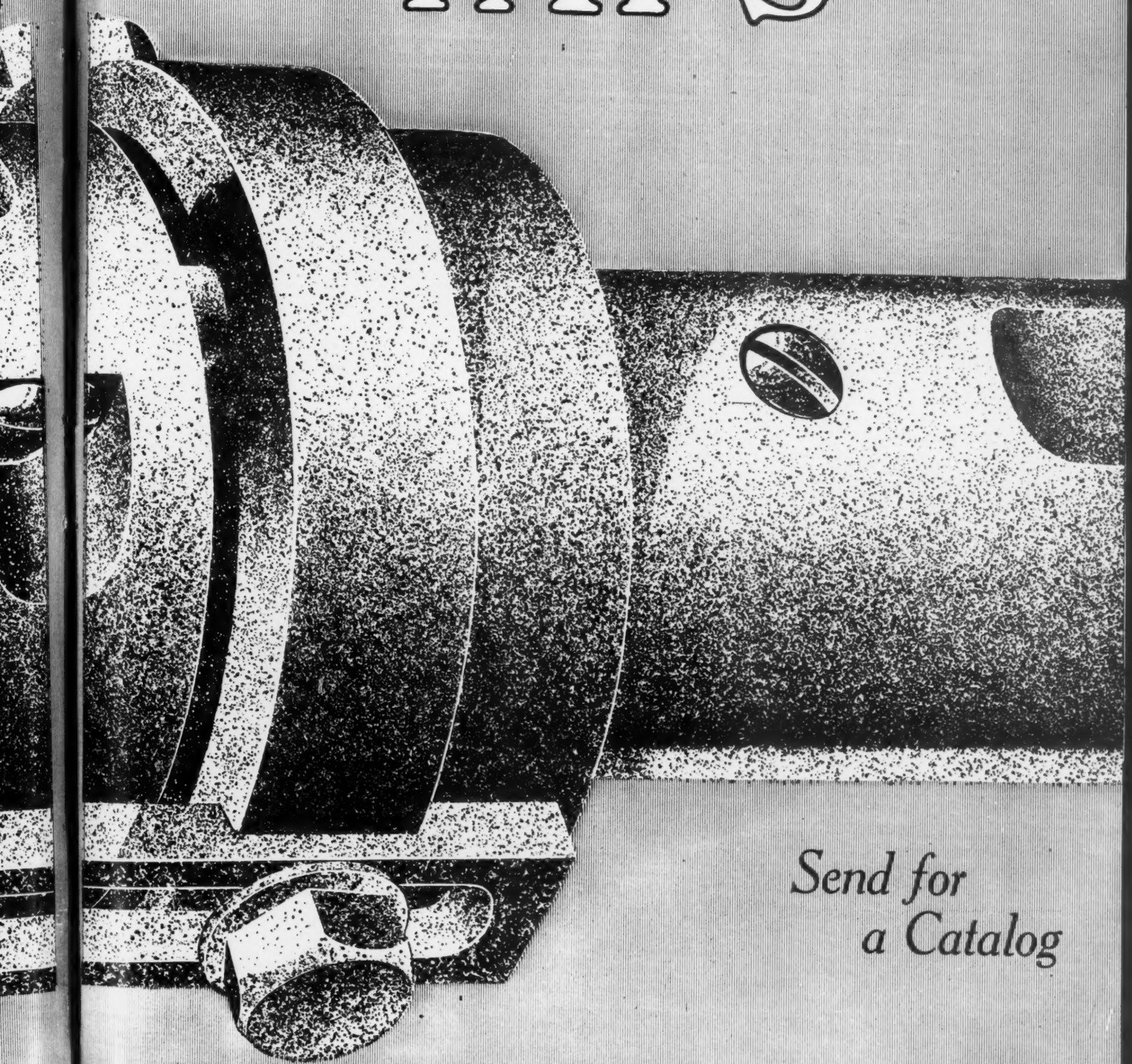


THE NATIONAL

New York, Boston, Chicago, Detroit, Buffalo

CLEVELAND,

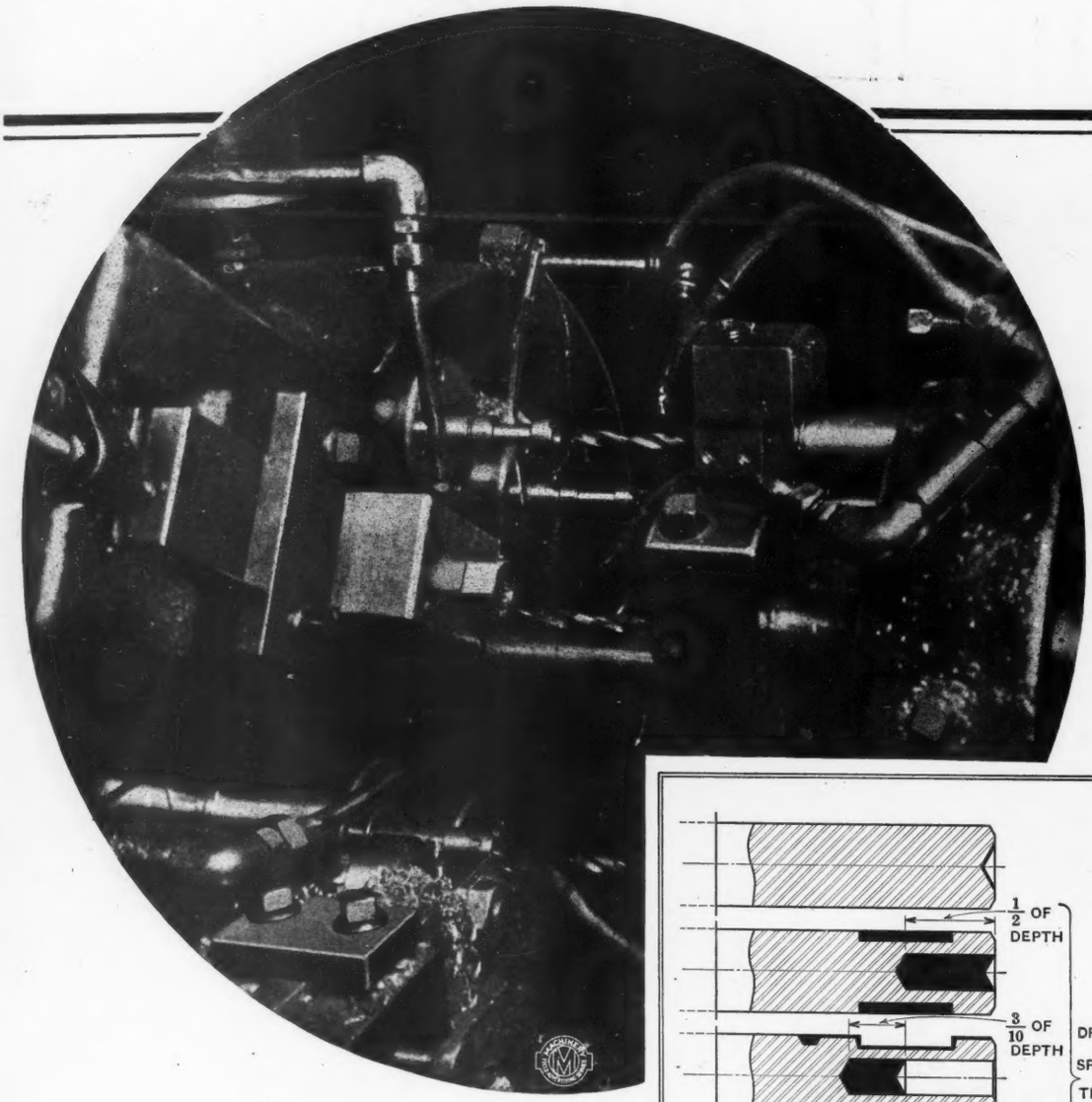
COLLAPSING
— TAPS —

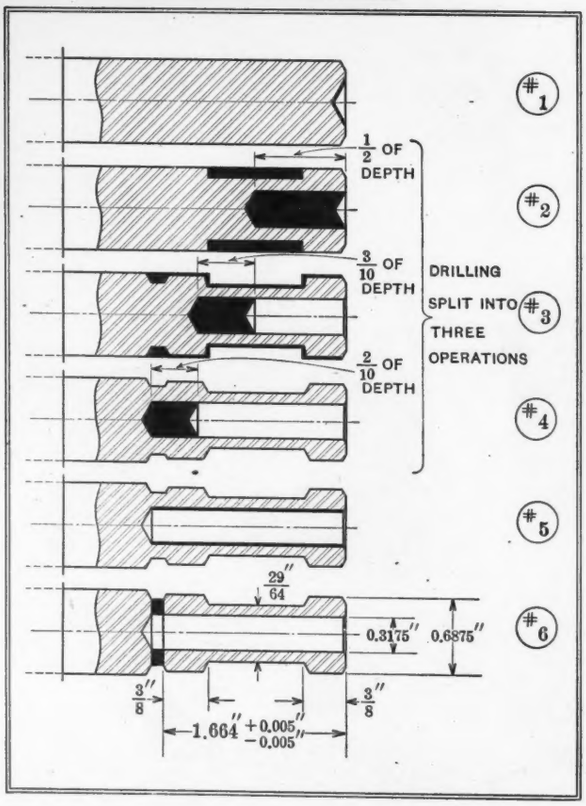


Send for a Catalog

ACME COMPANY

OHIO, Representatives in Principal Foreign Countries





A Part Produced Every Twenty-three Seconds

"NEW BRITAIN" NB NONE BETTER

NEW BRITAIN

Making Steel Gear Blanks on the "NEW BRITAIN" SIX-SPINDLE AUTOMATIC SCREW MACHINE

Two years ago the Up-to-Date Machine Works of Chicago decided that for accuracy, speed and economy in the production of small parts "New Britain" Automatics were unbeatable. Experience has confirmed the decision, and a complete "New Britain" installation is now in operation.

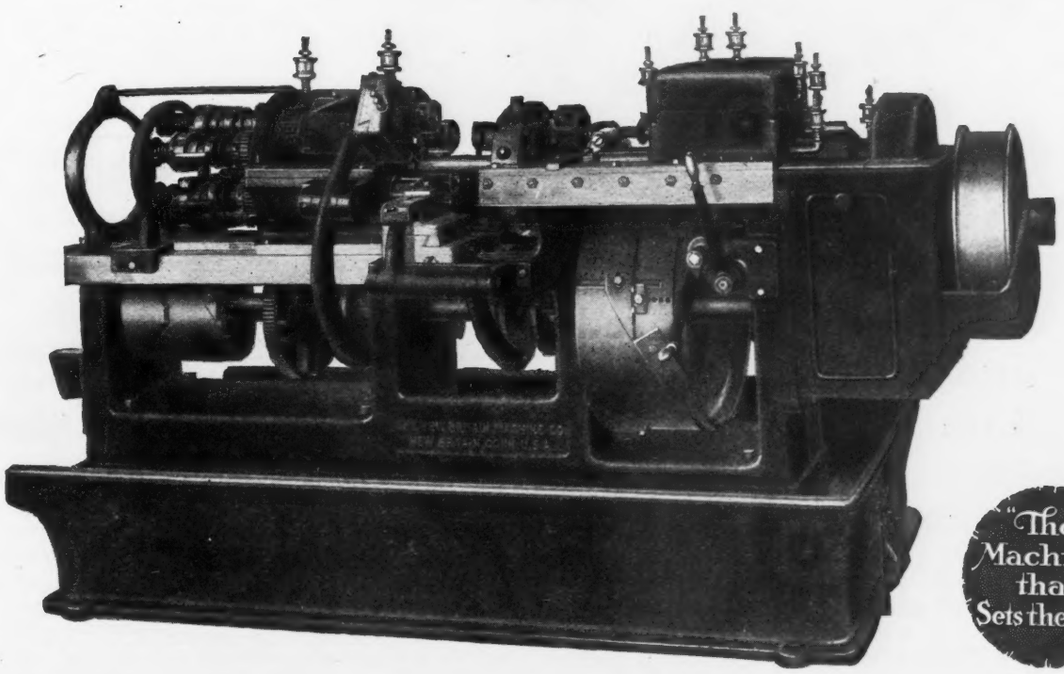
The work recorded by our cameraman was the making of speedometer steel gear blanks, the six operations being as follows: 1st—center; 2d—drill half of the hole and rough form, using side tool; 3d—drill three-tenths of depth of hole and finish form, using side tool; 4th—drill remaining fifth of depth of hole and face; 5th—ream, using accelerating reamer; 6th—cut off.

A finished gear blank is produced every twenty-three seconds.

Let us make a thorough investigation of your screw machine work, submitting estimate of productions to be expected from the "Six-spindle" Automatic.

THE NEW BRITAIN MACHINE COMPANY

New Britain, Conn., U. S. A.



"The Machine that Sets the Pace"

AUTOMATICS

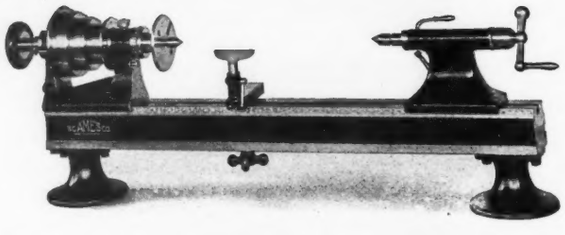
AMES BENCH LATHES

On Interchangeable Dies



Whiting & Comstock of Hartford, Conn., have been using Ames Bench Lathes for the past three years for all kinds of fine tool making, die work, gages, small screw machine work, etc. The machine here shown is a new installation.

Twenty-five Holes—Rough Bored, Bored and Reamed to Close Limits



When photographed, this machine was being used for boring out holes in an interchangeable armature die, one of three which are to duplicate each other so exactly that subsequent punchings will be interchangeable. There are 12 holes each in the outer and inner circles and one large hole in the center, their diameters being 0.390″, 0.203″ and 0.625″ respectively. Limits for spacing and boring are .001″. After boring these holes will be reamed. At the exact moment that the camera registered, one of the outer holes was being rough centered with the pointer. This is a nice piece of toolwork and the operator gives a large share of the credit for its successful performance to the accuracy and convenience of the Ames Bench Lathe.

All operations handled on these machines are equally satisfactory and the owners are correspondingly well pleased. Let us send the catalog.

THE B. C. AMES COMPANY

WALTHAM **MASS., U. S. A.**

REED-PRENTICE COMPANY

WORCESTER MASS. U.S.A.



An Announcement

A combination of the Executive-Sales-Purchasing-Auditing Accounting and Advertising Departments of the Reed-Prentice Company, Becker Milling Machine Company and Whitcomb-Blaisdell Machine Tool Company has been made.

These three companies owned and operated by the same financial interests have one main purpose in view—Service. To insure this service the companies have been linked together that their combined products can be marketed by direct factory sales branches located in the principal machine tool centers of the United States.

Your requirements will be handled by salesmen trained in machine tool manufacture and use. This allows your needs to be analyzed intelligently and the maximum results rendered.

You will find us gladly willing to co-operate with you to the end that you may achieve the best production.

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Whitcomb-Blaisdell Machine Tool Company, 134 Gold Street.
Charles Hildreth, Pres. and Gen. Mgr.
F. H. Seng, Sales Department.

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P. K. Dayton, New York Sales Manager.
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HYDE PARK, BOSTON:—Becker Milling Machine Company.

Scott Taylor, Works Manager.
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A. S. Morse, Salesman, Cutter Dept.
A. McDonald, Salesman, Cutter Dept.

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F. C. Hermann.
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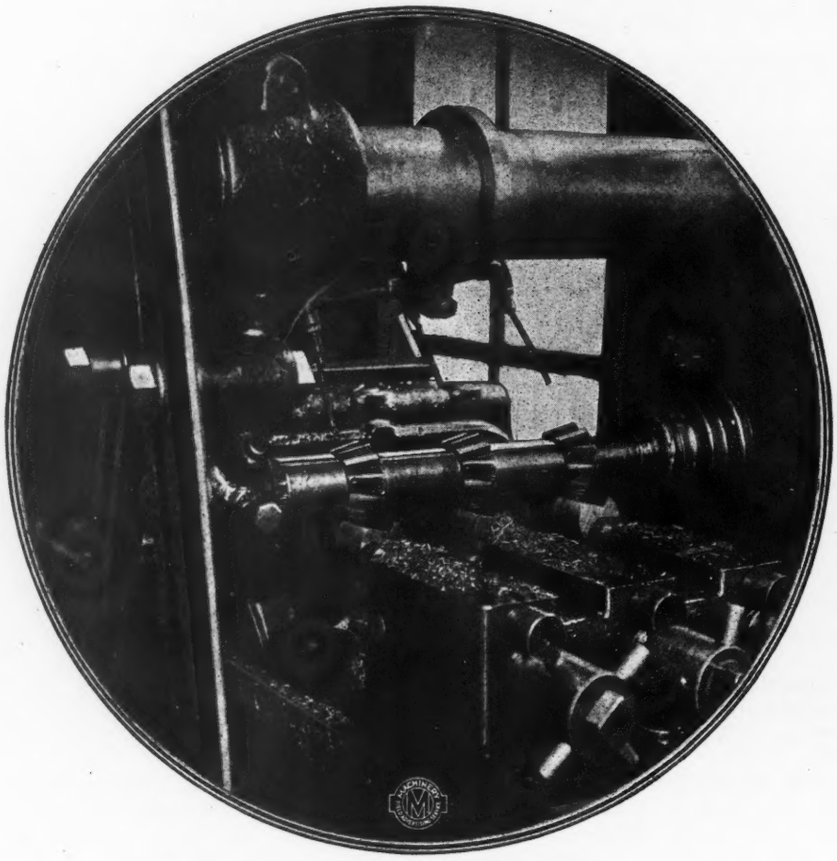
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GARVIN MACHINE TOOLS



Milling Taps is Speedy Work With GARVIN MILLING MACHINES

Taps and dies on a production basis—all kinds, all sizes; a continuous demand to be met. That's the proposition of the Winter Brothers Company of Wrentham, Mass., and to solve it considerable thought has to be given to the choice of equipment.

Five Garvin Milling Machines help a whole lot in speeding up production while maintaining the concern's reputation for a quality product.

The photograph shows the milling of four flutes on 1½" pipe tap. Three of these parts are milled at once, production being 55 per nine-hour day.

The operator runs four machines.

The Garvin Catalog is both complete and interesting. Send for a copy today

The Garvin Machine Company

Spring and Varick Streets NEW YORK, N. Y.

GARVIN

BUILDER OF BETTER MACHINE TOOLS

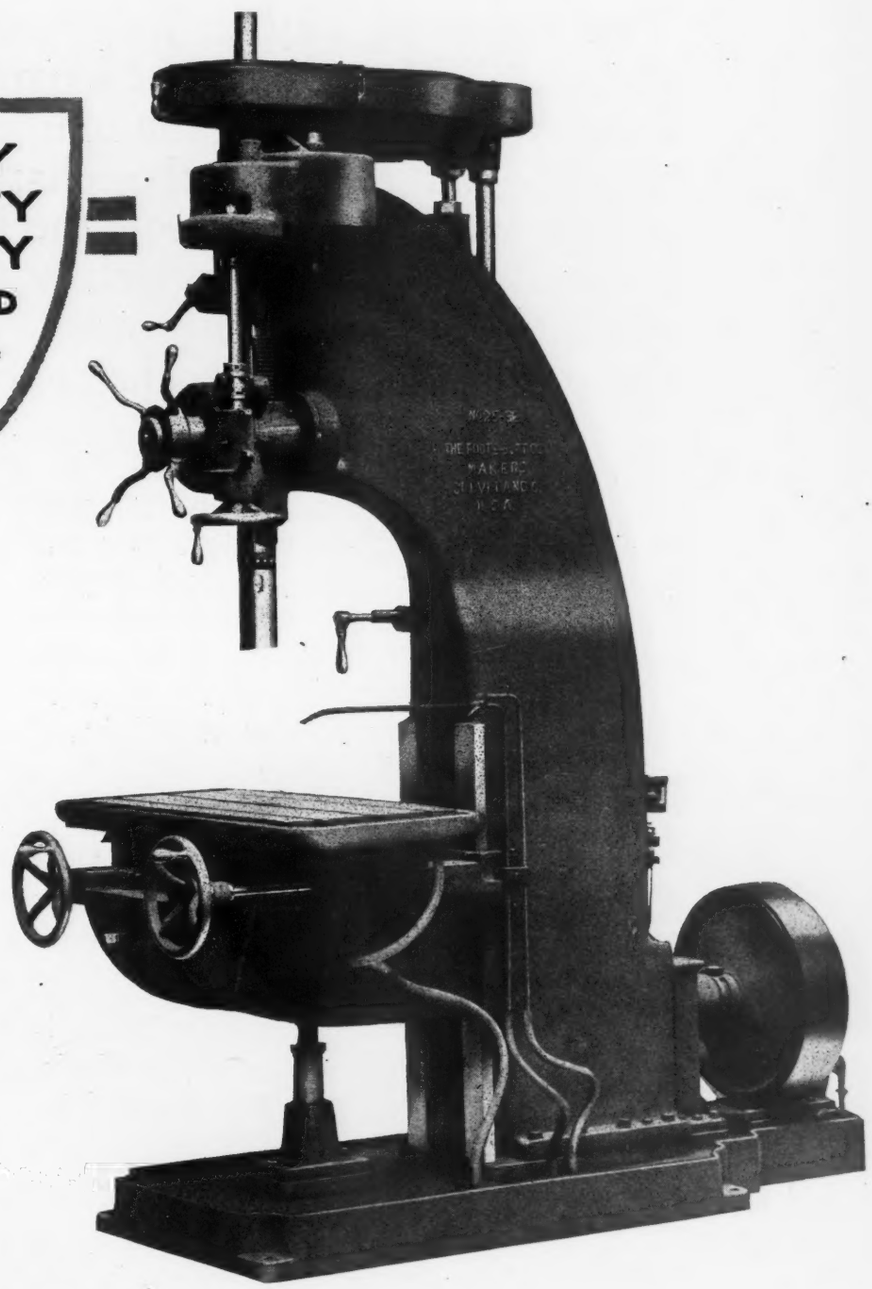
REMEMBER FOOTE-BURT

When you Want a Drill to Work Hard and Keep at it

When your requirements call for a High Duty Drill to work hard and keep everlastingly at it, then you need a Foote-Burt. The pertinent features are its rigid construction, adaptability to a wide range of work, simplicity of construction and operation, and centralized control.

RIGIDITY
DURABILITY
SIMPLICITY
CENTRALIZED CONTROL

FB



Write us for more particulars or have your purchasing department do so—do it now while you have the matter in mind.

The Foote-Burt Co.
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FOREIGN AGENTS: Buck & Hickman, Ltd., London, Birmingham, Manchester and Glasgow. Moscow Tool & Engine Co., Moscow. Ing. Ercole Vaghi, Milan. R. S. Stokvis & Zonen, Ltd., Rotterdam. R. S. Stockvis & Fils, Brussels. Glaenzer & Perraud, Paris, agents for France, Switzerland, Spain and Portugal. Mitsui & Co., agents for Japan, Korea and Manchuria.

FOOTE-BURT HIGH DUTY DRILLS ARE BUILT TO LAST

WILLIAMS' "AGRIPPA" TOOL HOLDERS

Comparison

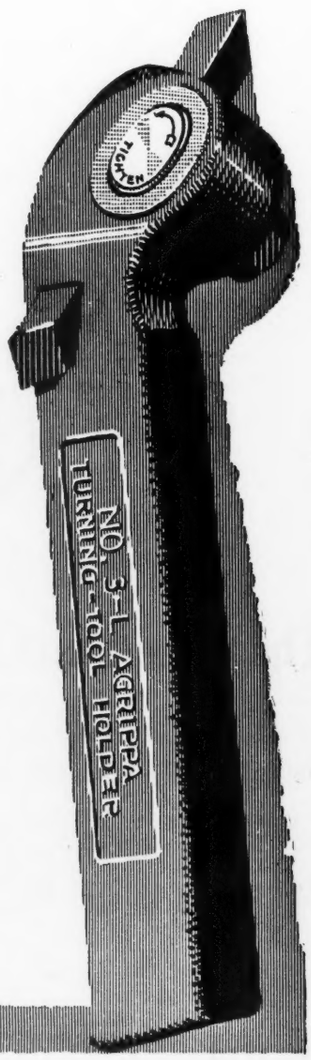
That's a good way to judge men—comparison. When you want a particular job done, you don't select the man indiscriminately; you *compare* the characteristics of Jim and Bill. You know the work each is capable of doing—which is the better qualified for your purposes. And you make your selection accordingly.

It's the same with Tool Holders.

We suggest that you watch the performance of the Tool Holders you use *now*. Watch them closely—note their production—their need of adjustment—the quality of their work. *Then*, on a harder job, with tougher material, heavier cut and faster speed, use a Williams' "Agrippa" Tool Holder.

The result will show that our claim, "Williams' 'Agrippa' Tool Holders, *'The Holders that Hold,'* assure better quality and greater production," is well founded.

In stock for all regular machining operations: Turning, Boring, Planing, Threading, Knurling, Cutting-off and Side Work. Ask for a copy of our new Machinists' Tools Book.



J. H. WILLIAMS & CO.

"The Drop-Forging People"

BROOKLYN, N. Y. 61 Richards Street
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UNIVERSAL
(Horizontal)
BORING MACHINE

Three Years in Service and No Repairs

This is the record that stands to the credit of the Universal Boring Machine which for three years has been in continuous use in the Saginaw plant of the Wilcox Motor & Manufacturing Company.

This machine has been in constant operation, without let up, taking heavy cuts for long periods; but its accuracy has not been impaired in any way.

The photograph shows this "Universal" boring a cylinder for a special machine.

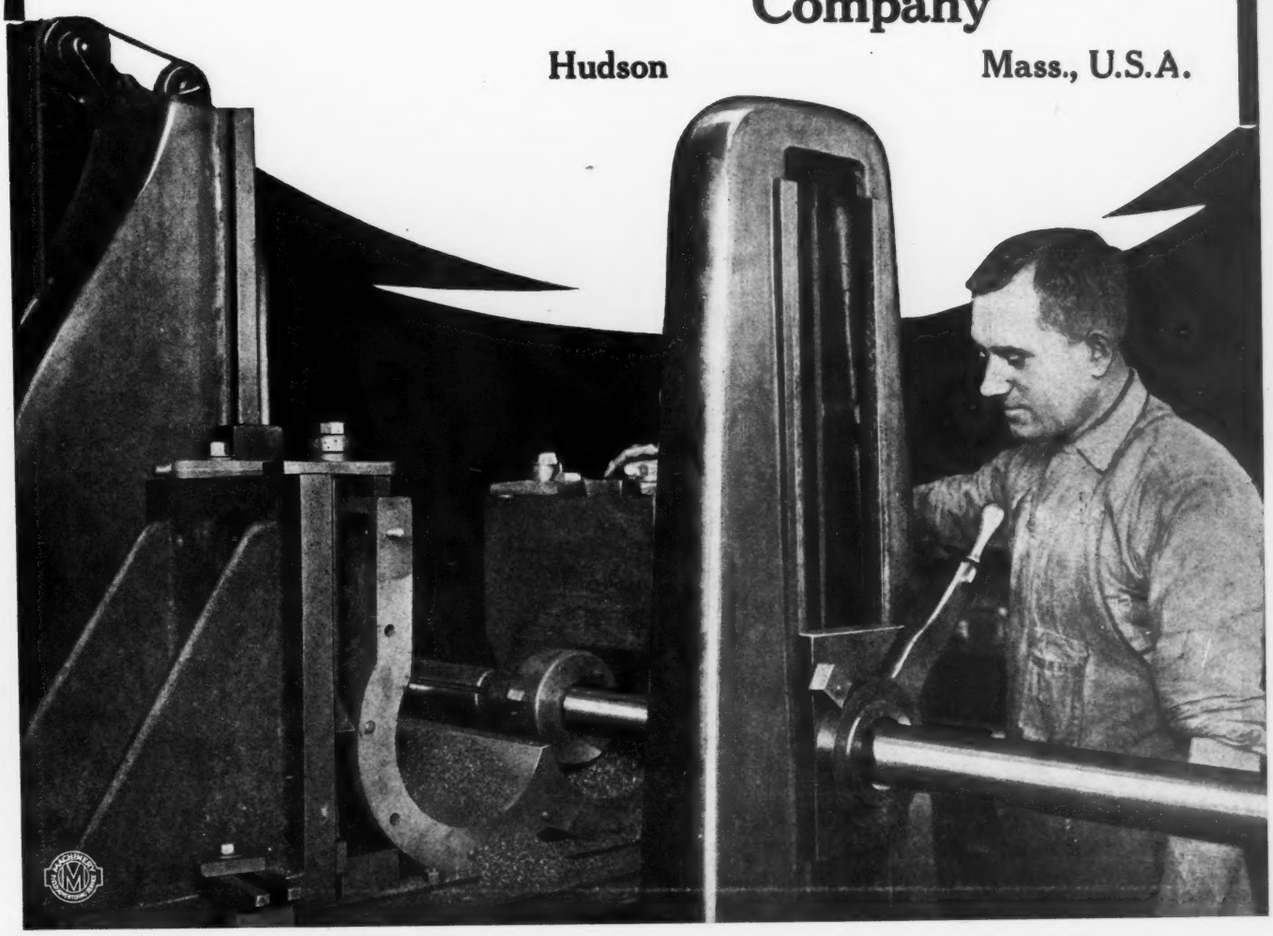
Honest attention to details is a paying investment for us as well as it is for the concern who buys our machine.

"Where Accuracy Counts—We Win"

Let Us Show You.

Universal Boring Machine Company

Hudson **Mass., U.S.A.**

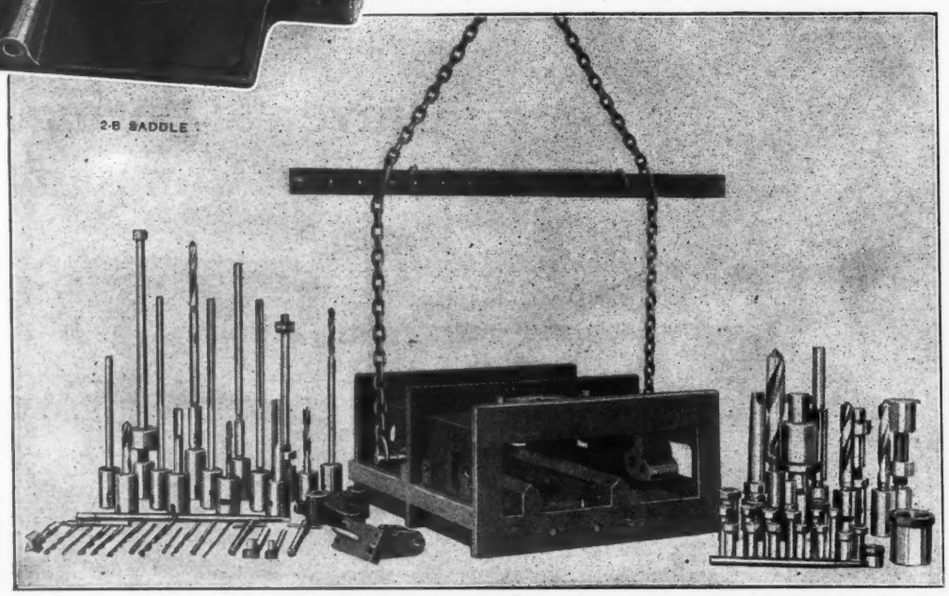


MOD

"Magic" Chucks



As Used By
The Foster Machine Co.,
Elkhart, Ind.



In the Foster Bulletin showing operations which contribute to the high quality of Foster turret lathes, two groups of tools used in Modern "Magic" Chucks are shown. Above is the view showing the gear box. The Foster Concern pays "Modern" a very nice compliment in showing these views and explaining that it is through such operations that Foster Quality is secured. The array of tools used in Modern "Magic" Chucks is surely impressive. For changing small tools quickly there is nothing so efficient as a

Modern "Magic" Chuck

MODERN TOOL COMPANY

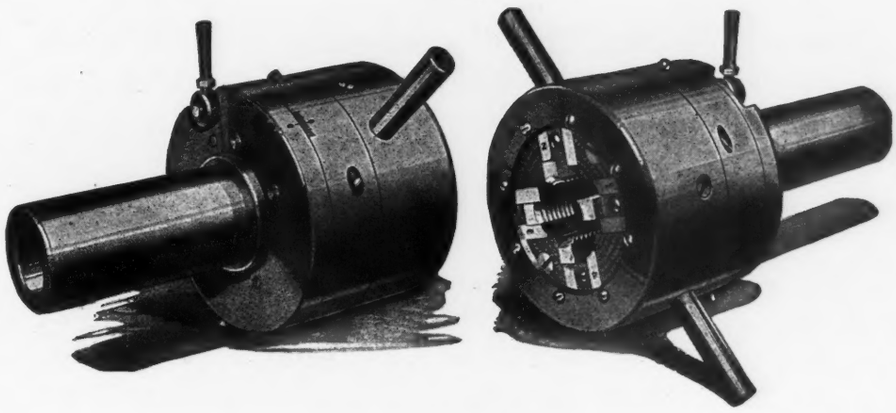
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Self-Opening Die Heads

17 SIZES



STYLE "H"

Accuracy ***Dependability*** ***Durability***

"Modern" Die Heads are noted for these three qualities. Inquiry of any of the thousands who use them will verify our claims.

The principle of construction, and the careful workmanship insure threads full size, true to lead.

The simplicity of "Moderns" is a real virtue. There is almost nothing to get out of order. They are therefore constantly on the job producing, instead of being frequently in the tool room for adjustment, or repair.

"Modern" Self-opening Die Heads last for many years. They are so rugged in construction that without gross abuse they should last a lifetime.

"Moderns" have an enviable record for volume of production; also for ability to handle difficult work. We should like to tell you about their accomplishments — better still, let us give you details of what they'll do on your own job. Send blueprints and specifications.

Send for complete technical bulletin.

ERIE, PENNSYLVANIA, U. S. A.

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We Are Old Enough to Know How

FIFTY-FIVE years ago, there was only one Machine Tool Merchant in New England—we were that one—you know how many there are today selling such machinery—but—there's a difference—and that's why we term ourselves MERCHANTS.

Noah Webster in his dictionary doesn't distinguish between the names Merchant, Dealer and Agent, but we must remember that learned gentleman lived many years ago.

Supposing you come in our office or we in yours—you hand us a blueprint or piece of work—you ask us what we recommend to do it—we tell you—you purchase it—and it does everything, if not a little bit more than we claimed—that's what we call being a Merchant.

And it's all because each and every man in our employ is a natural born mechanic—all of them have had practical shop experience—they know what they are selling.

We give service—it doesn't cost a cent—we are just as much interested in what you buy of us, a year or years afterwards, as on the day you put it under the belt.

We really can say—if it's a Machine Tool you want, we've got it.

HILL, CLARKE & COMPANY, Inc.

The Machinery Merchants

—And Young Enough To Do It!

Manufacturers Who Have Confidence In Us.

Badger Tool Co.,
Beloit, Wis.
Disc Grinders.

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Horizontal Boring Machines.

Western Machine Tool Works.
Holland, Mich.
Radial Drilling Machines, Plain and Universal, 3′ to 8′ arms.

Willard-Middletown Machine Co.,
Cincinnati, Ohio.
Inclinable Power Presses.

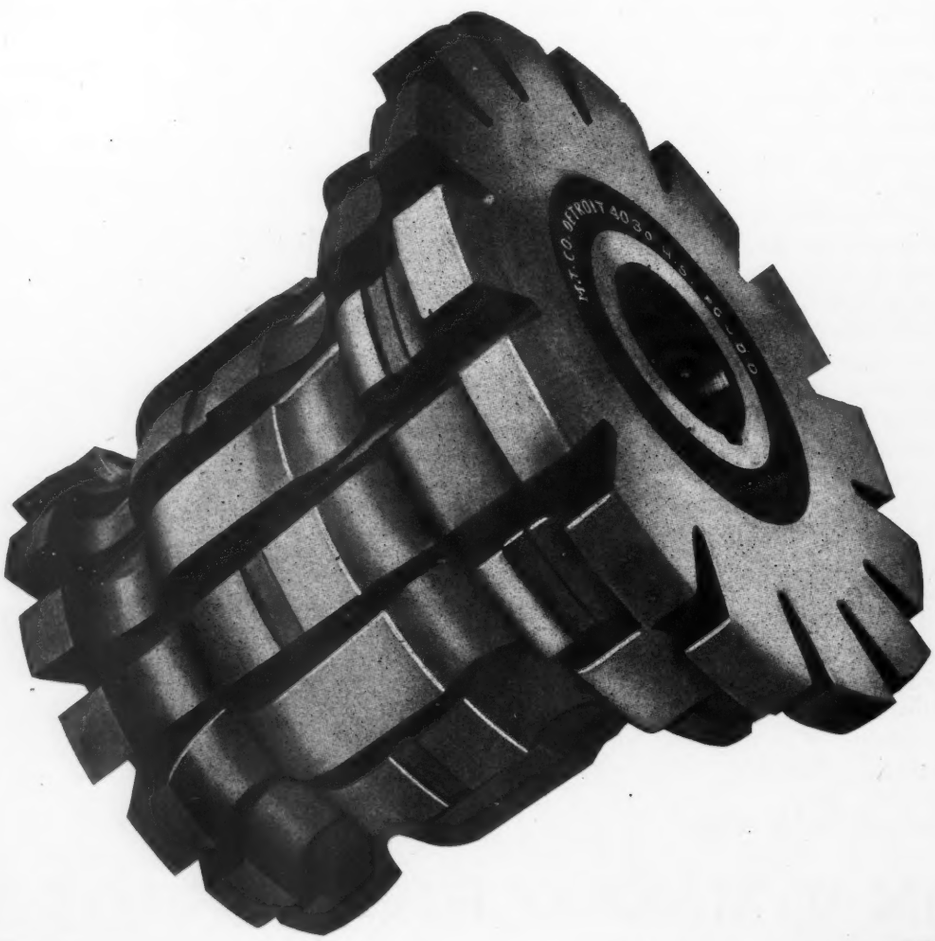
BOSTON 9, MASSACHUSETTS, U.S.A.

156 Oliver Street

Michigan Tool Co

DETROIT, MICH., U. S. A.

Milling Cutters, Hobs and Special Tools



WHITCOMB-BLAISDELL



An Announcement

A combination of the Executive-Sales-Purchasing-Auditing Accounting and Advertising Departments of the Reed-Prentice Company, Becker Milling Machine Company and Whitcomb-Blaisdell Machine Tool Company has been made.

These three companies owned and operated by the same financial interests have one main purpose in view—Service. To insure this service the companies have been linked together that their combined products can be marketed by direct factory sales branches located in the principal machine tool centers of the United States.

Your requirements will be handled by salesmen trained in machine tool manufacture and use. This allows your needs to be analyzed intelligently and the maximum results rendered.

You will find us gladly willing to co-operate with you to the end that you may achieve the best production.

BOSTON:—53 Franklin Street
A. H. Weed, President.
Graydon Stetson, Vice-President.
J. W. Lund, Treasurer.
J. P. Ilsley, General Sales Manager.
F. W. McIntyre, Sales Manager.
V. A. Campbell, Sales Department.
F. E. Rhodes, Sales Department.
G. S. Haven, Sales Department.
F. H. Palmer, Purchasing Agent.
S. L. Crawford, Advertising Manager.

WORCESTER:—Reed-Prentice Company, Cambridge Street.
A. E. Newton, Vice-Pres. and Gen. Mgr.
F. K. Hendrickson, Engineering Dept.
Whitcomb-Blaisdell Machine Tool Company, 134 Gold Street.
Charles Hildreth, Pres. and Gen. Mgr.
F. H. Seng, Sales Department.

NEW YORK:—5th Floor, Grand Central Palace
P. K. Dayton, New York Sales Manager.
P. A. Dyer.

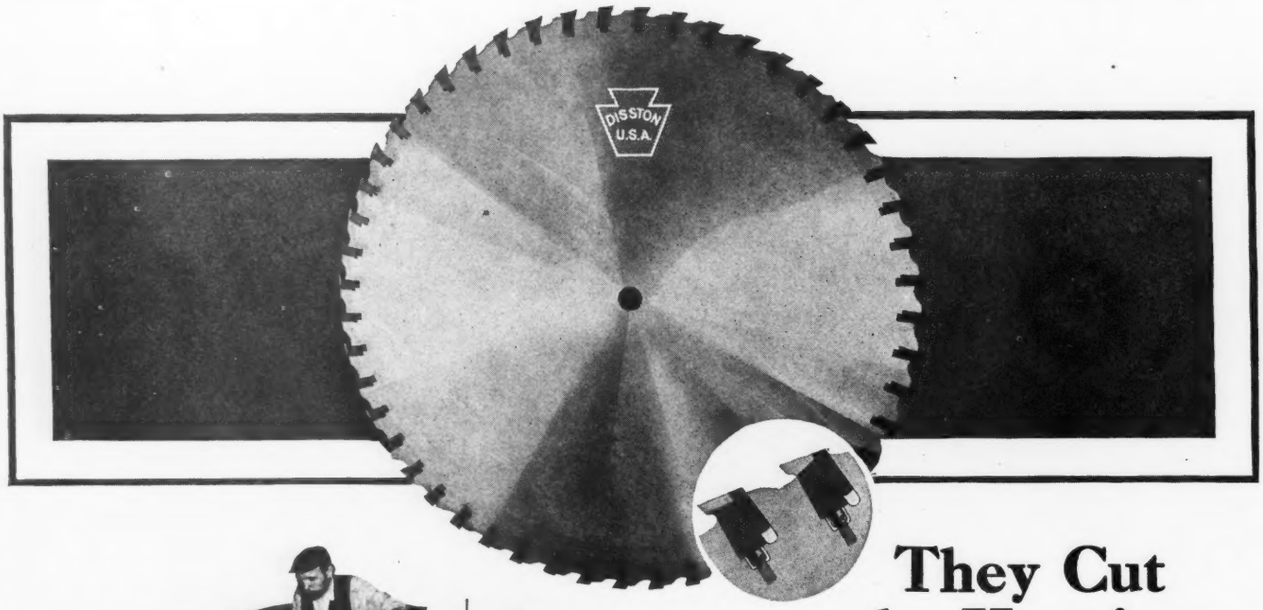
HYDE PARK, BOSTON:—Becker Milling Machine Company.
Scott Taylor, Works Manager.
H. S. Sawyer, Mgr. Cutter Dept.
A. S. Morse, Salesman, Cutter Dept.
A. McDonald, Salesman, Cutter Dept.

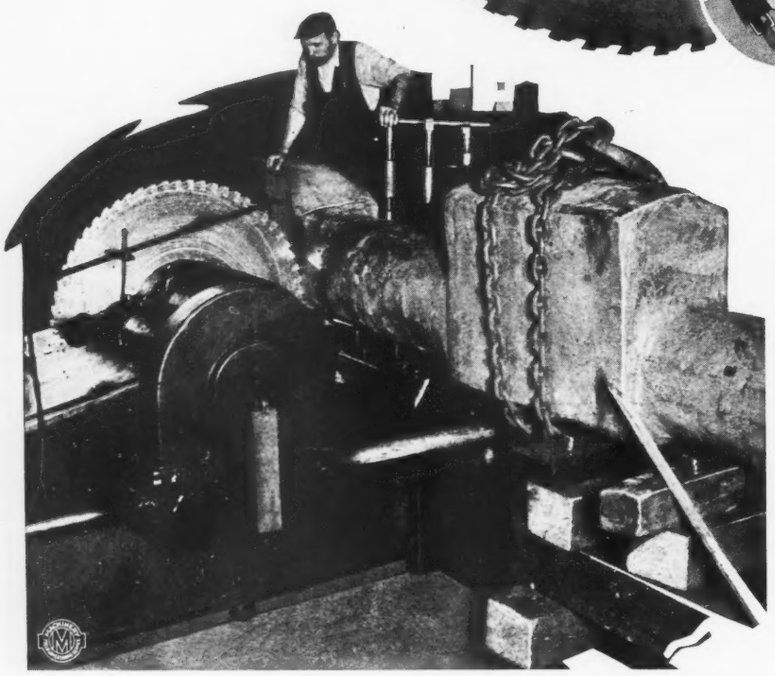
CHICAGO:—Temporary Office—621 Washington Blvd., c/o R. E. Ellis Engineering Co. About August 1 or 15th—26 and 28 N. Clinton Street.
W. D. Creider, Chicago Sales Manager.
F. C. Hermann.
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CLEVELAND:—408 Frankfort Avenue.
C. A. Severin, Cleveland Sales Manager.
Charles Brandhill.

INDIANAPOLIS:—940 Lemcke Annex Bldg.
T. C. McDonald, Indianapolis Sales Mgr.





They Cut the Heaviest Steel Forgings

The heaviest steel forgings present no difficulties to the Disston Inserted Tooth Saws with which the plant of the Horsburgh Forge Company, Cleveland, Ohio, is well equipped. The photograph shows a Disston Inserted Tooth Saw, 48″ diameter, which, running at 3½ R.P.M. and carrying a heavy feed, rapidly cuts through a section 10¾″ x 31″. There's a Disston Saw for every metal cutting operation. You can't forget the name.

HENRY DISSTON & SONS, Inc.

PHILADELPHIA, U. S. A.

Chicago	Sydney, Australia	Memphis	San Francisco
New Orleans	New York City	Cincinnati	Portland, Oregon
Seattle	Boston	Bangor	Vancouver, B. C.

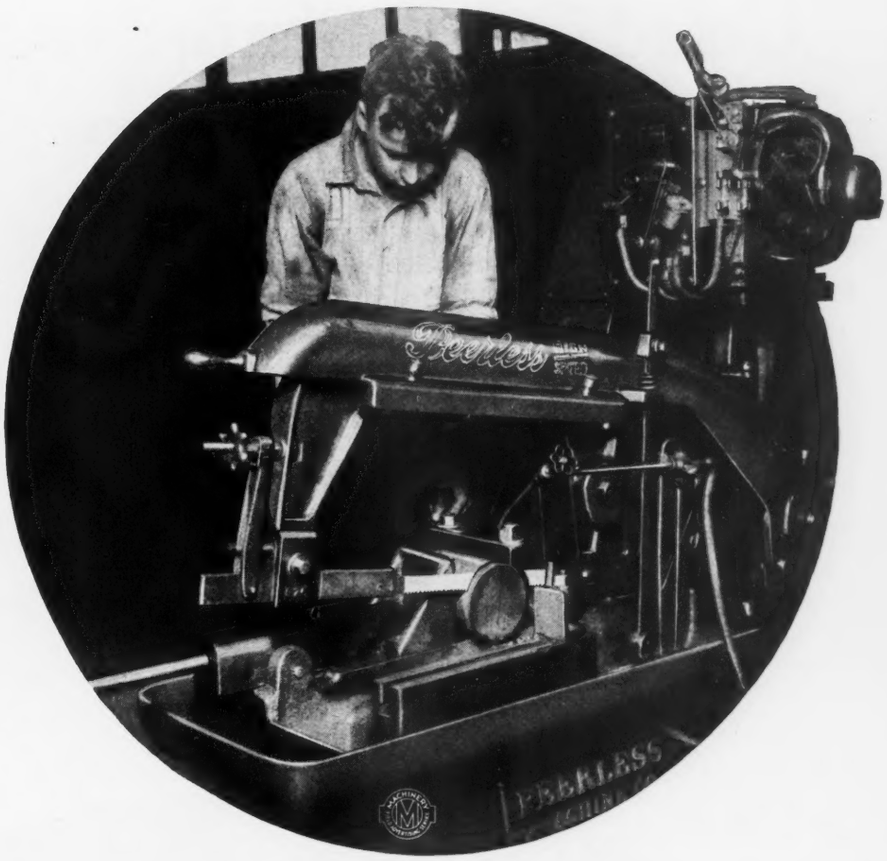
CANADIAN WORKS: TORONTO, CANADA.

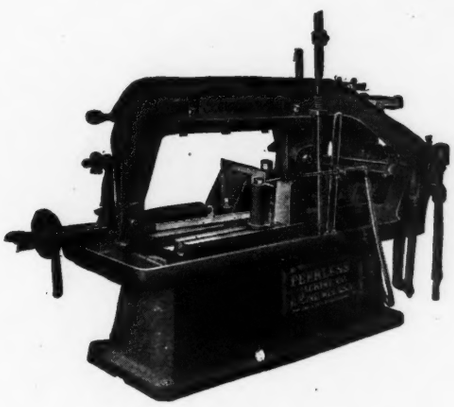
DISSTON

METAL CUTTING SAWS

WHEN THE DISC SAW FAILED

Another Triumph for the Peerless HIGH SPEED *Metal Cutting Machine*





You also will discard other methods when you see the money making possibilities of the "Peerless" which we will be glad to show you at any time. Write us.

Metal cutting in the Gardner Machine Co.'s plant, Beloit, Wis., is exacting work and the disc saw installed for the purpose failed to make good—so the Company replaced it with this Peerless High Speed Metal Cutting Machine and found the problem of cutting up stock solved once and for all.

"We find the 'Peerless' handy and convenient," said a member of the firm. "We like its durable construction and use it for work that a regular disc saw was bought to do and failed. The 'Peerless' costs little to run."

PEERLESS MACHINE COMPANY

1611 RACINE STREET, RACINE, WISCONSIN, U. S. A.

Use Peerless HIGH SPEED Tungsten Power Blades for Heavy Duty

LANDIS CRANK GR

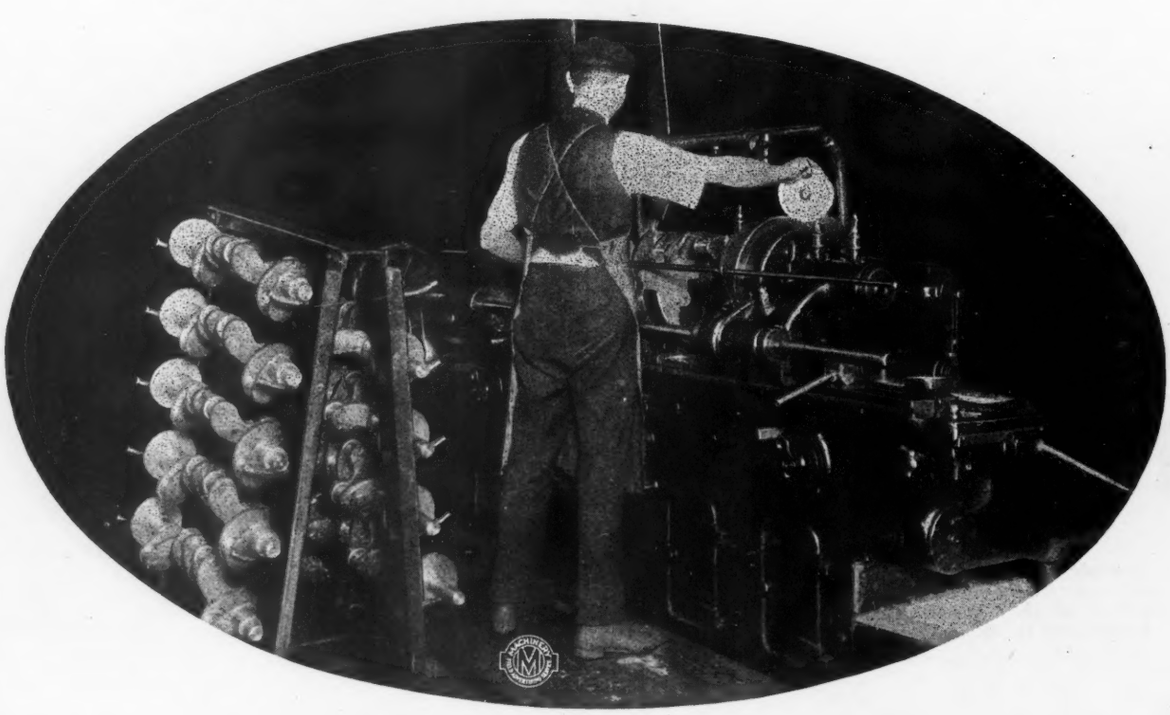
Grind Crank Shaft Pins to Close Limits Here

These photographs taken at the Mitchell Motors Company, Inc., Racine, (Wis.) plant show one of the Landis Crankshaft Grinders in use here. Especially designed for grinding and finishing both single and multiple throw crankshafts, and especially valuable in the manufacture of motors and gas engines for automobiles and launches, they have found special favor here.

Landis Crankshaft Grinders grind with accuracy and finish practically unobtainable by other methods; this with an increased output that tremendously reduces production costs.

The cranks are driven from both ends, as the head and footstocks are geared together; the throws are set for by a sliding adjustment of the work-carrying heads on the face-plates, and for multiple throw shafts the pins are ground in their exact relative position with each other. The work is easily and accurately held by quickly operated clamping holders at both ends—no offset centers are required.

Compare the operation and production given on the opposite page with work of the same class done by any other method; judge for yourself the reasons for the popularity of these machines.

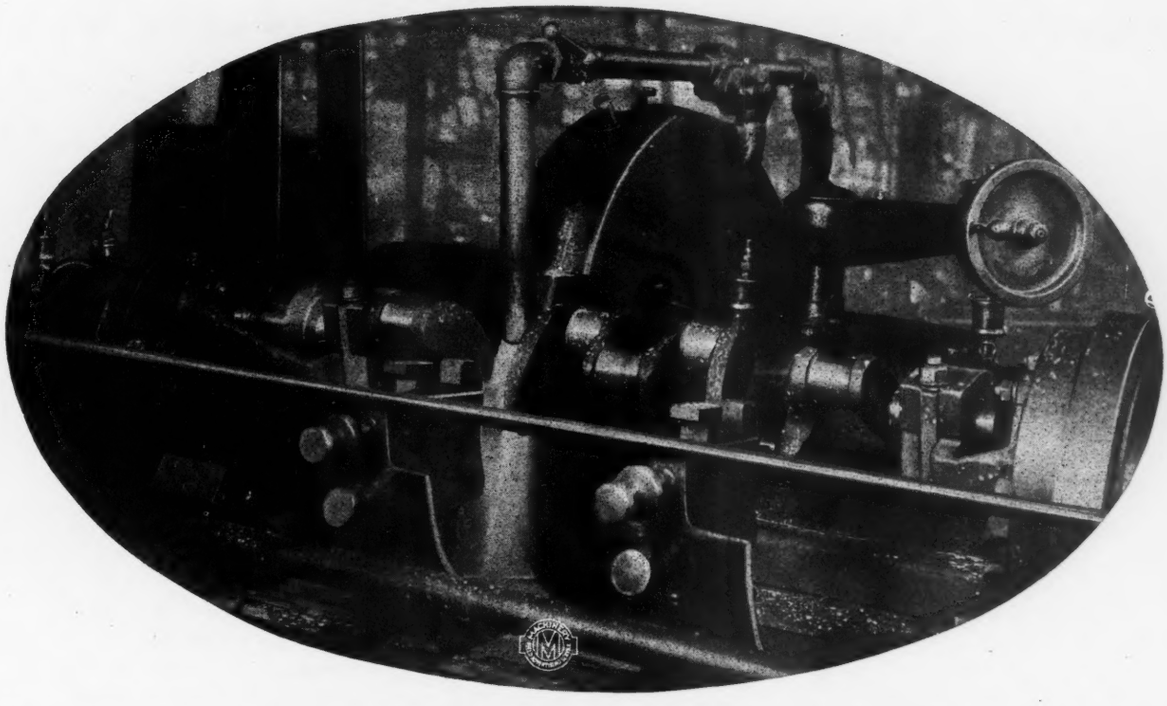


LANDIS TOOL COMPANY,

New York Office:

DOMESTIC AGENTS: Dewstoe Machine Tool Co., Birmingham; Elliott & Stephens Machinery Co., St. Louis; F. C. Richmond Ma-Hendrie & Bolthoff Mfg. & Supply Co., Denver; Seeger Machine Tool Co., Atlanta; Sheehan-North Co., El Paso.

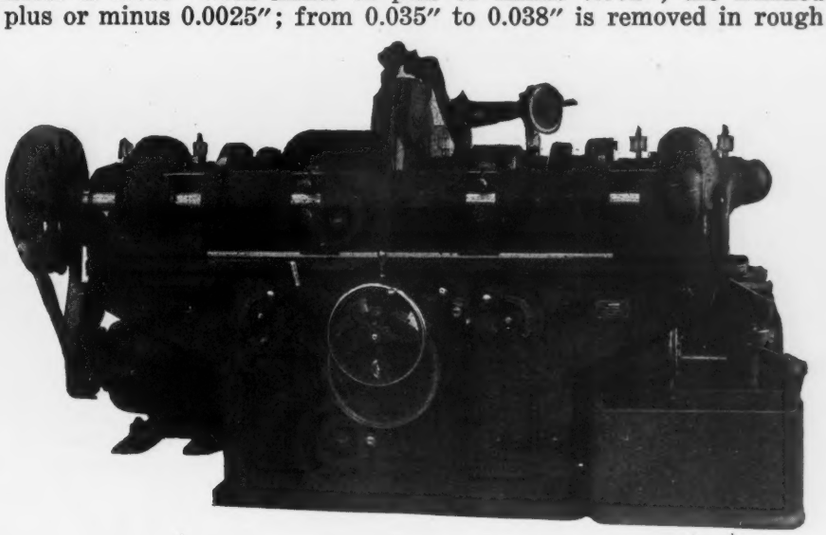
INDING MACHINES



"Landis Grinders are Fine Machines for Accurate Finishing" Says the Foreman

Mitchell crankshafts are of drop forged steel, S A E specification No. 1045, scleroscope hardness 38 to 48. They come to the Landis Grinders with the six pins turned within 0.050″ of the finished dimensions. The finished diameter is 2.000″ with limits of plus or minus 0.001″; the finished width is 2.250″ with limits of plus or minus 0.0025″; from 0.035″ to 0.038″ is removed in rough grinding and from 0.012″ to 0.015″ is removed in the finish grinding operation; production is 25 finished crankshafts per ten-hour day on each machine.

Send for the complete catalog of Landis Grinding Machines. See pages 44 to 53 for the details of the machine shown here.



LANDIS

WAYNESBORO, PA., U. S. A.

50 Church Street

chinery Co., Salt Lake City; Hallidie Machinery Company, Seattle; Harron, Rickard & McCone, San Francisco and Los Angeles;

BECKER



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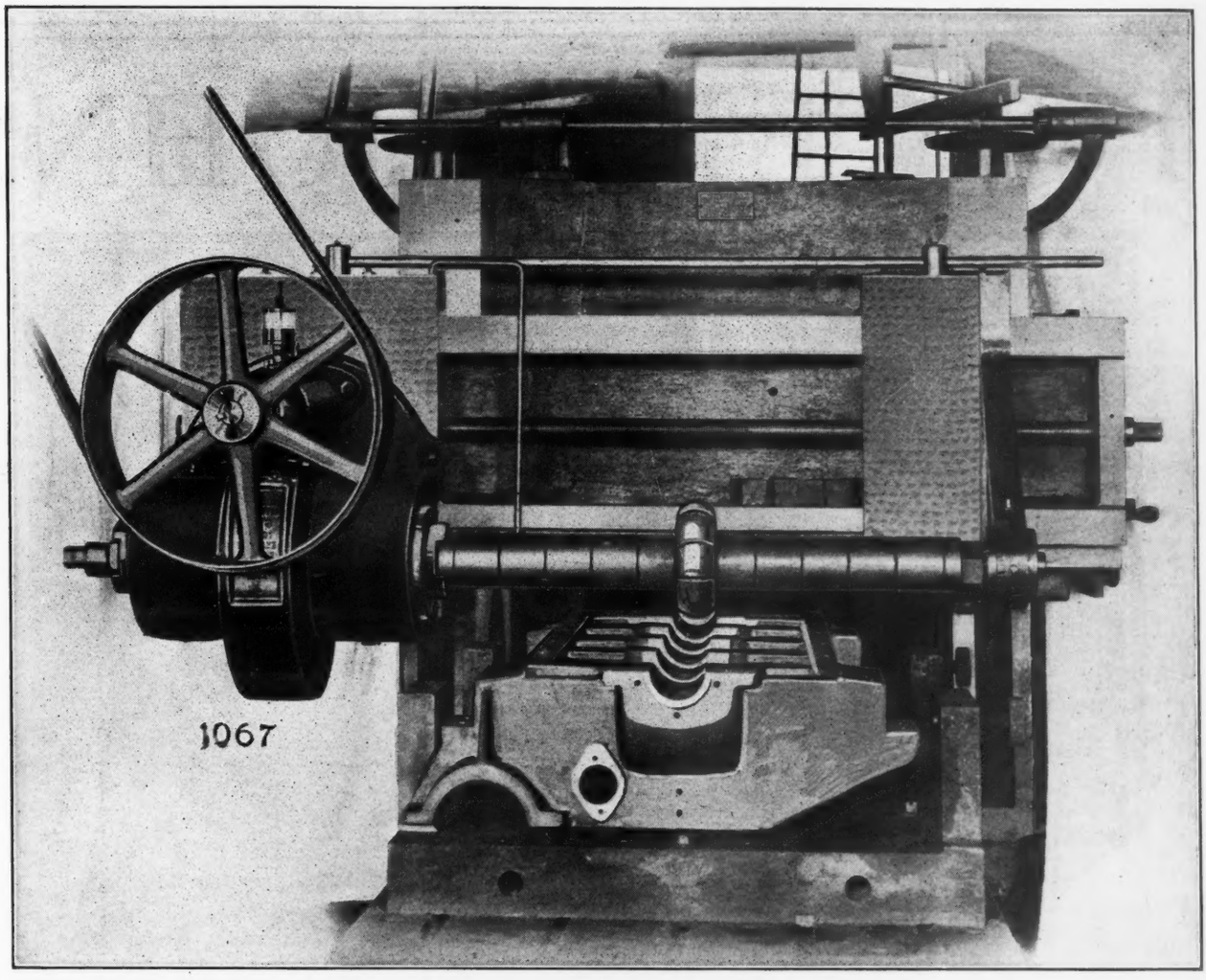
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Charles Brandhill.

INDIANAPOLIS:—940 Lemcke Annex Bldg.
T. C. McDonald, Indianapolis Sales Mgr.



FARWELL MILLING MACHINE FOR PLANERS

The above illustration shows a No.3 Farwell Milling Machine milling crank cases for 5½ x 7 inch engine, in the plant of the Pittsburgh Model Engine Co., Peru, Indiana. This crank case has five main bearings, four of which are 3½ inches in length, the other one being 5 inches long. A 10-tooth high speed radius cutter, 8 inches in diameter, 1 3/16 inches radius, is used, and milling is done at a speed of 42 feet per minute, with a feed of .020 per revolution. The cutting time on this job is 35 minutes, with about 10 minutes consumed in loading the jig ready for milling.

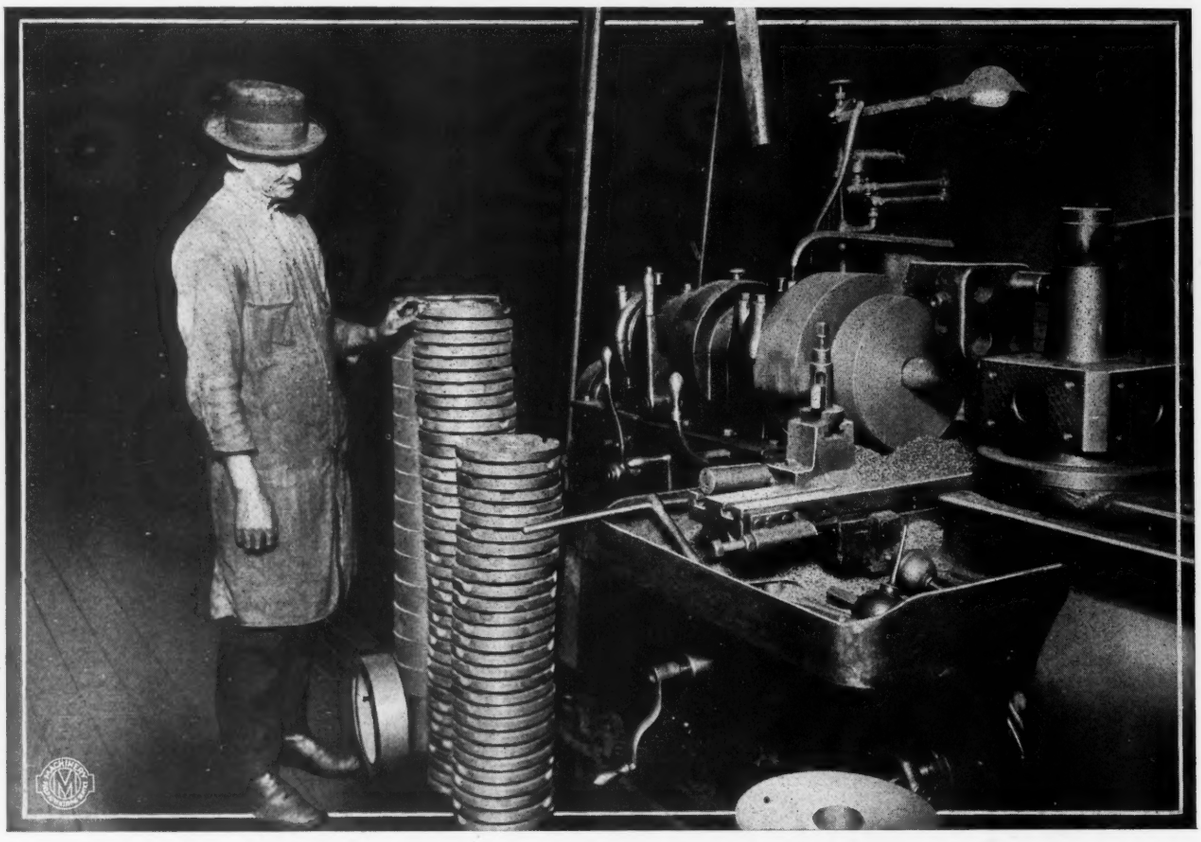
If you have difficult jobs in milling to handle, do not go to the expense of purchasing a large and expensive machine. Utilize your planer for this purpose, by installing a Farwell Milling Machine on the rail. This sturdy machine will make your planer capable of turning out the work of a big powerful vertical and horizontal milling machine, boring mill and planer. This machine interferes in no way with the operation of the planer, as it may be slid to the overhang of the planer rail when not in use.

Write for a copy of our catalog No. 58, in which are illustrated many of the unusual operations this equipment is capable of performing.

THE ADAMS COMPANY, 1908 Market Street Dubuque, Iowa, U.S.A.

ESTABLISHED 1883

POTTER & JOHNS



Piling Up Production With Potter & Johnston Automatics

High cost of production, expensive raw material, keen competition! What is the best way to synchronize production with this situation? Automatic machinery? Obviously!

Production by a series of operations on many machines, means wasted time and effort, frequent failures to make deliveries on schedule, the possible paying of a forfeit.

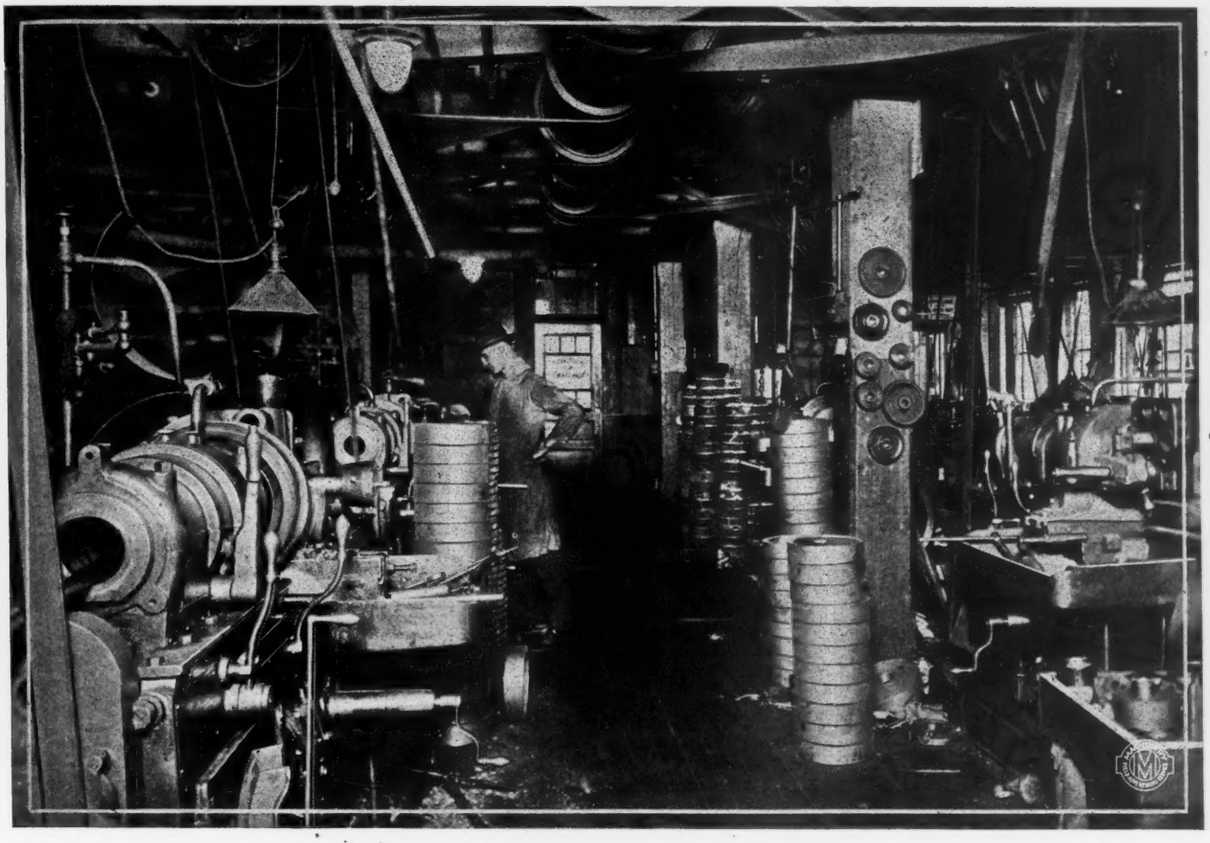
All this is changed when you install Potter & Johnston Automatics —you chuck another piece when one is completed, that's all. Then with a P. & J. installation, you can lay your work out far in advance—each day's production is pre-determined.

P. & J. Production Figures on your work are always available. Mail blueprints.

Potter & Johnston,

OFFICES AND REPRESENTATIVES: Great Britain, France, Italy, Belgium, Switzerland, Spain and Portugal; 68 Avenue de la Grand Armee, Paris, J. Ryan, Manager. New York Office, Fulton Bldg., 50 Church St., Walter H. Foster Co., Managers. Detroit Office: Modern Machinery & Engineering Co., 1514 Ford Bldg. Chicago Office: 1001 McCormick Bldg., Chas. H. Shaw,

TON AUTOMATICS



An Installation of P. & J. Automatics in the Terkelsen & Wennberg Company's Factory, Boston, Mass.

You can figure your quotations closer than your unequipped competitor because fluctuations in costs have little effect on your production.

With Potter & Johnston Automatics you know exactly where you are at today, where you will be at tomorrow—or three months hence. What wonder that the call for Potter & Johnston Automatics from many widely varying industries grows greater every day!

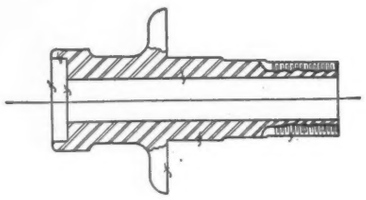
Let us make an estimate of P. & J. equipment which would best solve your present problems.

Pawtucket, R. I., U. S. A.

Manager. Toronto Office: 1501 Royal Bank Bldg., E. C. Roelofson, Manager. FOREIGN AGENTS: Chas. Churchill & Co., Ltd., London, Birmingham, Manchester and Newcastle-on-Tyne, England and Glasgow, Scotland. Ercole Vaghi, Corso Porta, Nouva 34, Milan, Italy.

They do This *"Stunt"* Every Eight Minutes

"It's quite a stunt," said the visitor as he was shown a part which the production manager told him had been turned in eight minutes. "Don't you wish you could get that speed in regular production?" It was quite a shock when the visitor learned that eight minutes *was* average production, and that the lathe responsible for the work was a "Libby".



First operation: to chuck casting by large flange, bore, turn and thread and face the flange. Second operation (casting held by threaded portion, pulling finished face of flange back against plate), face end and recess. Time to complete, eight minutes.

We estimate on all kinds of unusual lathe work. How about yours?

INTERNATIONAL MACHINE TOOL CO.

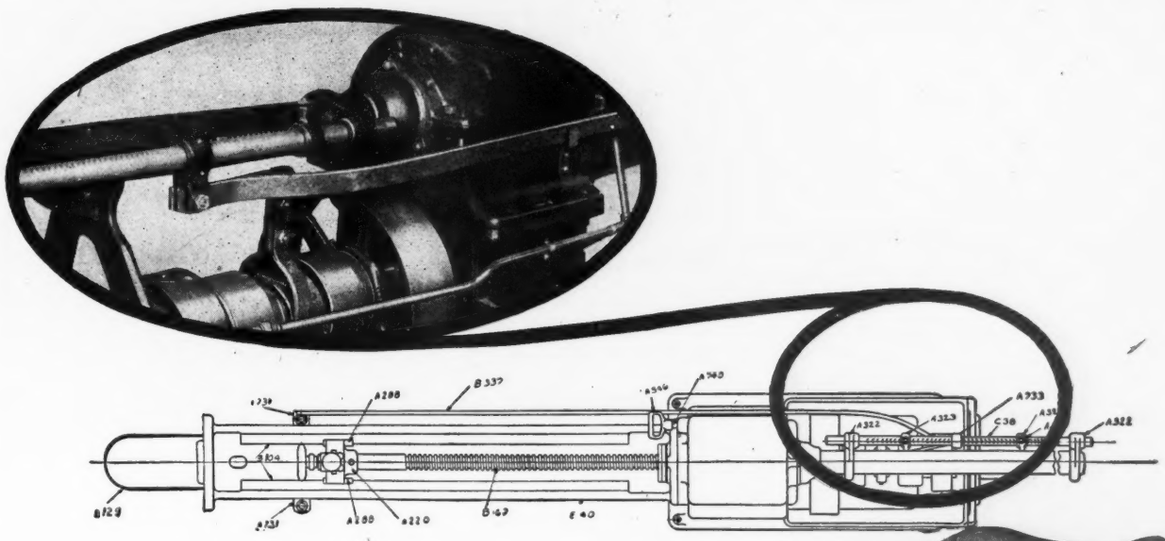
INDIANAPOLIS, INDIANA, U. S. A.

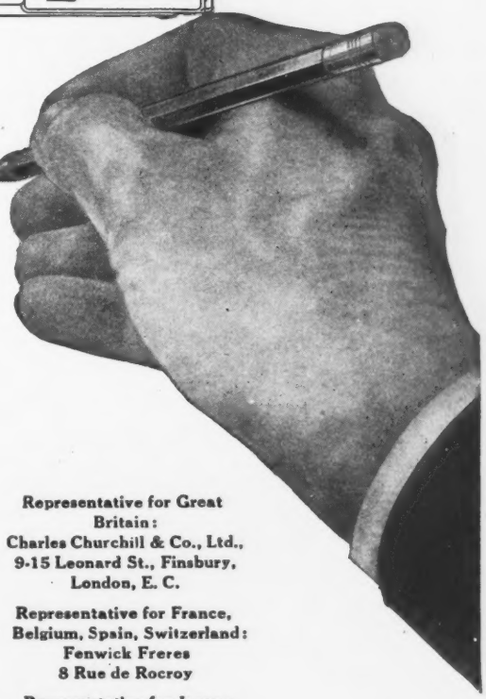
DOMESTIC AGENTS: Blackman-Hill-McKee Machinery Co., St. Louis, Mo. Brown & Zortman Machinery Co., Pittsburgh, Pa. Eccles & Smith Co., San Francisco, Cal., Los Angeles, Cal., Portland, Ore. E. L. Essley Machinery Co., Chicago, Ill., Milwaukee, Wis., and Moline, Ill. Strong, Carlisle & Hammond Co., Detroit, Mich., and Cleveland, Ohio. Vandyck-Churchill Co., New York, N. Y., New Haven, Conn., and Philadelphia, Pa. Syracuse Supply Co., Syracuse, N. Y., and Buffalo, N. Y. Aumen Machinery Co., Baltimore, Md. Northern Machinery Co., Minneapolis, Minn. Seifreat-Woodruff Co., Cincinnati and Dayton, Ohio. FOREIGN AGENTS: Coats Machine Tool Co., Ltd., London, Eng. Iznosskoff & Co., Petrograd, Moscow and Ekaterinburg, Russia. Hijo De Miguel Mateu, Barcelona, Spain. Isbecque & Company, Belgium. Moerch & Roumet, Paris, France. V. Lowener, Copenhagen, Denmark; Chrisiania, Norway; Stockholm, Sweden.



Photograph by courtesy of St. Louis Malleable Casting Company.

"Speed with the Work and the Tool Protected"





J. N. Lapointe Co

During the entire stroke, cutting and return, the travel of the screw on a J. N. Lapointe Co. Broaching Machine is under instant control of the operator—to whose hand a lever is conveniently placed on each side of the machine.

But the length of each stroke may be set by means of dogs on the knock-off shaft which stop the movement of the screw and apply the brake automatically. Thus any damage to work or broach which might result from inattention or misjudgment of the operator is prevented.

The knock-off stops are mounted on a ratchet so that they may be adjusted by hand without the use of a wrench. Their action is positive and automatic. With this protection for the work and the tool, the entire attention of the operator may be devoted to more rapid production.

Safe speed—dependable accuracy—these are salient advantages in broaching machines made by the

Representative for Great Britain:
Charles Churchill & Co., Ltd., 9-15 Leonard St., Finsbury, London, E. C.

Representative for France, Belgium, Spain, Switzerland:
Fenwick Freres 8 Rue de Rocroy

Representative for Japan:
Commercial Co. of Tokio, Tokio

J.N. LAPOINTE CO.
OF NEW LONDON, CONN.

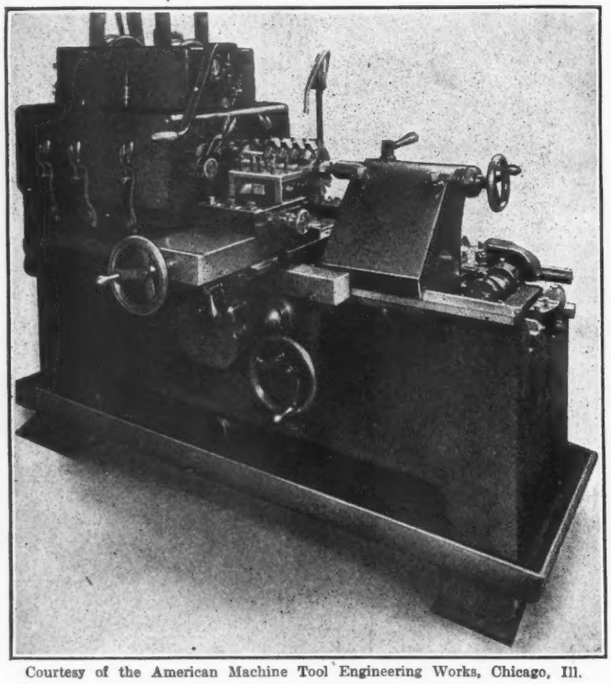
DETROIT OFFICE: 31 HARPER AVENUE

Makers of Broaching Machines and Broaches.

2066-L

THE JOHNSON FRICTION CLUTCH

Countershaft and Machine Combined by the Use of a Johnson Clutch



Courtesy of the American Machine Tool Engineering Works, Chicago, Ill.

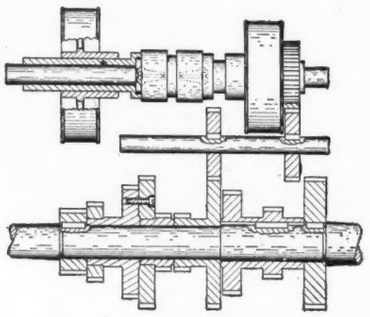
Self-contained Unit Construction on the Hack Relieving Machine

By mounting a compact Johnson Double Clutch on the drive shaft, the Hack High Power Universal Relieving Machine obtains a complete countershaft—with stopping, starting and reversing functions—built right into the headstock of the machine itself.

The neatness of this construction, its saving of space and equipment, deserve the attention of every machine builder. Johnson Clutches offer many other ways of simplifying power control—always supplying a smooth-running, durable mechanism adapted to any form required.



DOUBLE CLUTCH EXTERIOR



Johnson Clutch Installation on the Hack Relieving Machine

Send for our booklet "Clutches As Applied to Machine Building." Also our "Catalog A."

FOREIGN AGENTS

CANADA: Williams & Wilson, Ltd., 84 Inspector St., Montreal. The Canadian Fairbanks-Morse Co., Ltd., Montreal and branches. ENGLAND: The Efandem Co., Ltd., 22 Newman St., Oxford St., London, W. 1. AUSTRALIA: Edwin Wood, Pty., Ltd., 231 Elizabeth St., Melbourne, Victoria. FRANCE: Anciens Etab. Glaenzer & Perreaud, 18 Faubourg du Temple, Paris. SPAIN: R. D'Aulignac, Cortes 559, Barcelona. BELGIUM: Louis Reyners, Rue de la Buanderie 71, Brussels. HOLLAND: Louis Reijners, Kloveniersburgwal, 101, Amsterdam. DENMARK and SWEDEN: Wilh. Sonesson & Co., Copenhagen and Malmo. NORWAY: Oscar C. M. Knudsen, Odinsgate 4, Christiania. ARGENTINA: Pedro Merlini, Calle Defensa 124, Buenos Aires. INDIA: J. D. Jones & Co., 56 Esplanade Road, Fort, Bombay.

THE CARLYLE JOHNSON MACHINE CO. MANCHESTER CONN.

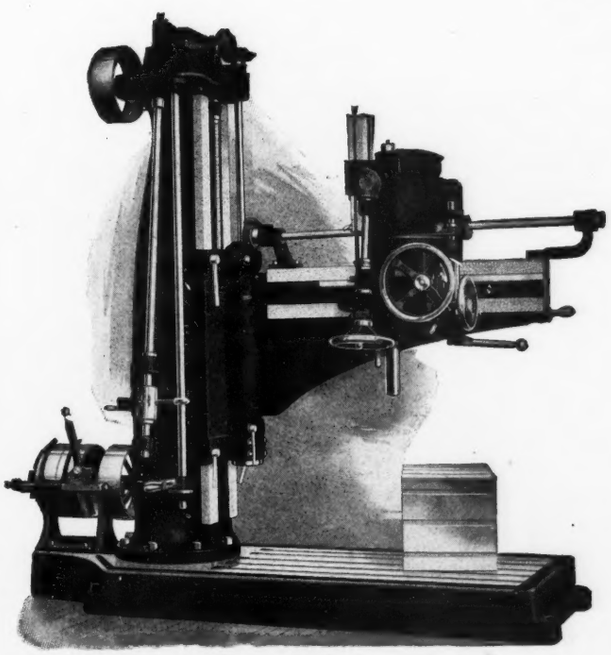
WESTERN
RADIAL DRILLS



This photograph of a Western Radial Drill in the shops of the Universal Boring Machine Co., Hudson, Mass., shows this versatile machine in operation on an unwieldy piece of work—a boring head for the Universal Boring Machine to be drilled and tapped with 144 holes in sizes ranging 3/16″ to 5/8″ in diameter.

A good test for the accuracy of the Western Radial—an apt illustration of its versatility and convenience.

We Say They are Versatile Machines—Here's a Job That Proves It



Accuracy, versatility, range and convenience are machine tool characteristics almost equally important to economical production.

Western Radial Drills have all these things—that is why their popularity is constant and ever growing, why they are used by so many builders of well known machines.

Send for the details of Western Radial Drills. A post card will bring our circular.

WESTERN MACHINE TOOL WORKS

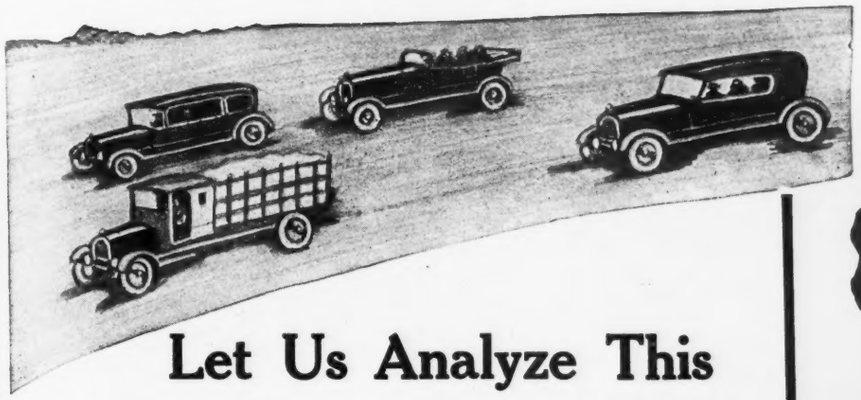
HOLLAND MICHIGAN, U. S. A.

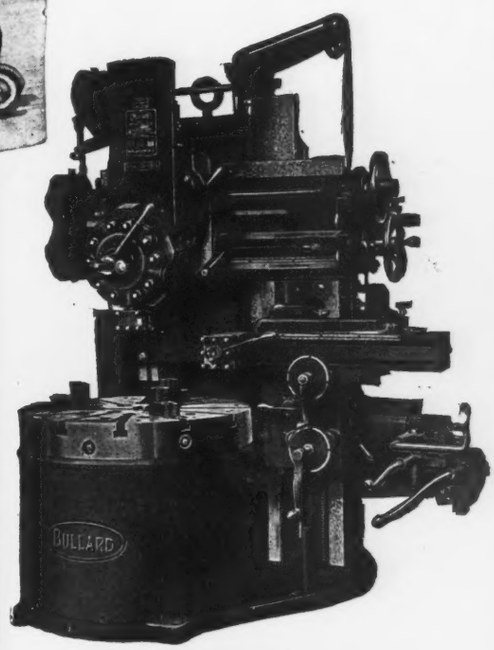
90 Per Cent of *All* Fly Wheels Made in America are Being



TO BULLARDIZE is to secure the greatest profit per man, per machine, per minute, per inch of floor space.

of *All* Trucks and Cars Turned out on BULLARDS





Let Us Analyze This "90% Story of Bullardization"

Any machine or any method (Bullard machines are both) that can supersede former methods ninety per cent must have phenomenal production-boosting and cost-cutting features. Bullards have.

Every Bullard Mult-Au-Matic or Vertical Turret Lathe sold had to prove its right to installation. This leads us to the question of what earns this installation right. And the answer is "greatest profit per man, per machine, per minute, per inch of floor space." The answer is the definition of a term that is heard everywhere in these days of intensive production—BULLARDIZE.

Sixty to eighty per cent savings in time over former methods is the record of every BULLARD in operation not only in machining flywheels but pistons, gear blanks, sprockets, differential cases, truck wheels and dozens of motor parts as well.

Not only is this work being done much quicker, but it is being accomplished with fewer men, releasing valuable operators for other important work and saving floor space, which today is an item of great importance.

Bullardization of production on the machining of castings, forgings or bar stock cut in sections should command first place in your fight for greater production.

VERTICAL TURRET LATHE

Cuts Time Between Cuts

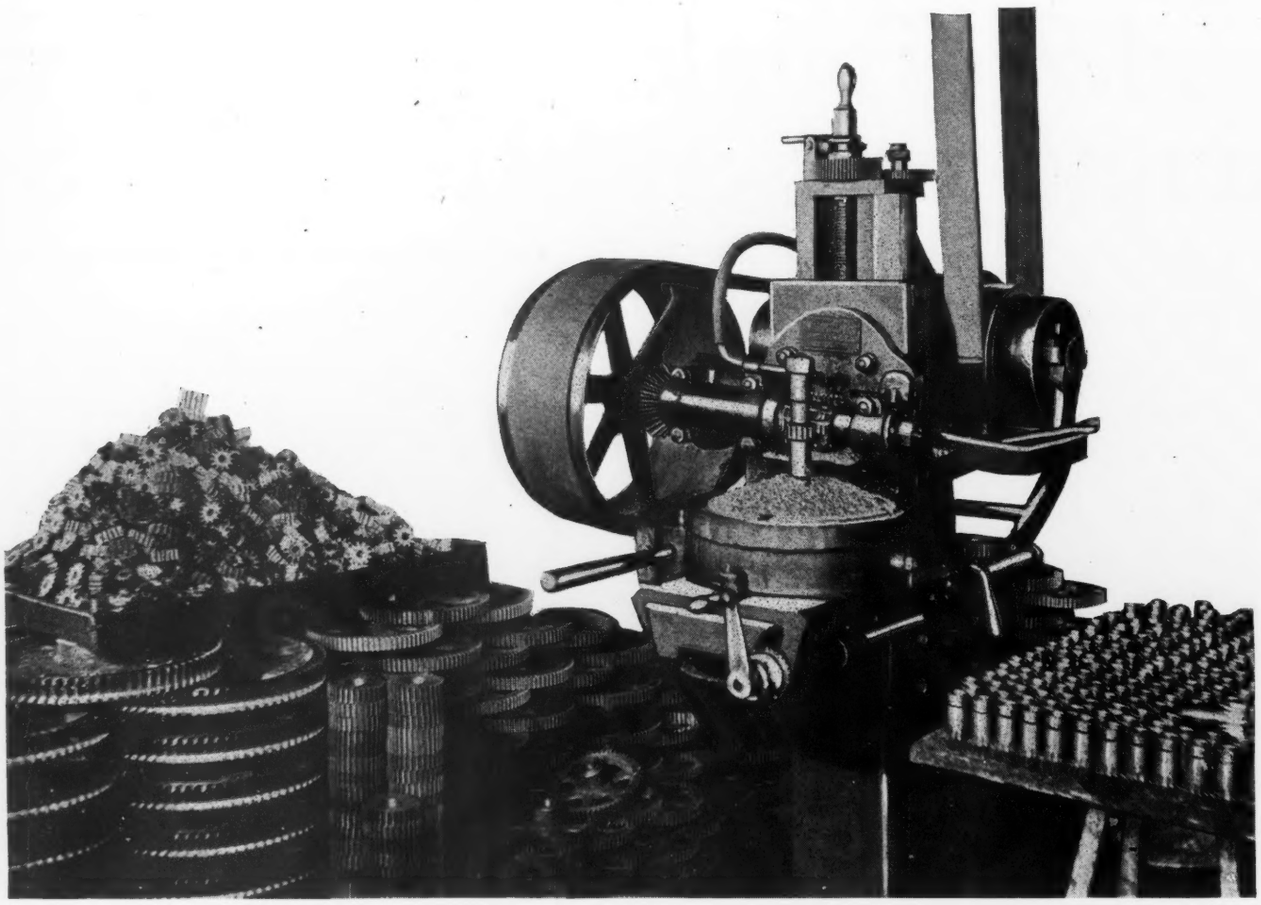
Let Bullard Engineers assist you. Send blue print or sample piece. Literature on request.

BULLARD MACHINE TOOL COMPANY

BRIDGEPORT **CONNECTICUT, U. S. A.**

Also Builders of the Production-famous Maxi-Mill

BULLARDIZE
YOUR PRODUCTION



Read what Alling-Lander Co., Sodus, New York, say about the efficiency of the No. 1 Farwell Gear Hobber

"We beg to advise that the following gears were cut in fifty-four hours, including setting up the machine six times:

200—12 tooth, 10 pitch, ½" face, ¾" bore, steel pinions (with shank).
400—12 tooth, 10 pitch, ½" face, 7/16" bore, steel pinions.
92—30 tooth, 10 pitch, 11/16" face, ¾" bore, cast iron pinions.
60—60 tooth, 10 pitch, 11/16" face, ¾" bore, cast iron gears (with hub).
60—80 tooth, 10 pitch, 11/16" face, 1" bore, cast iron gears (with hub).
24—80 tooth, ½" pitch, 1¼" face bronze worm gears.

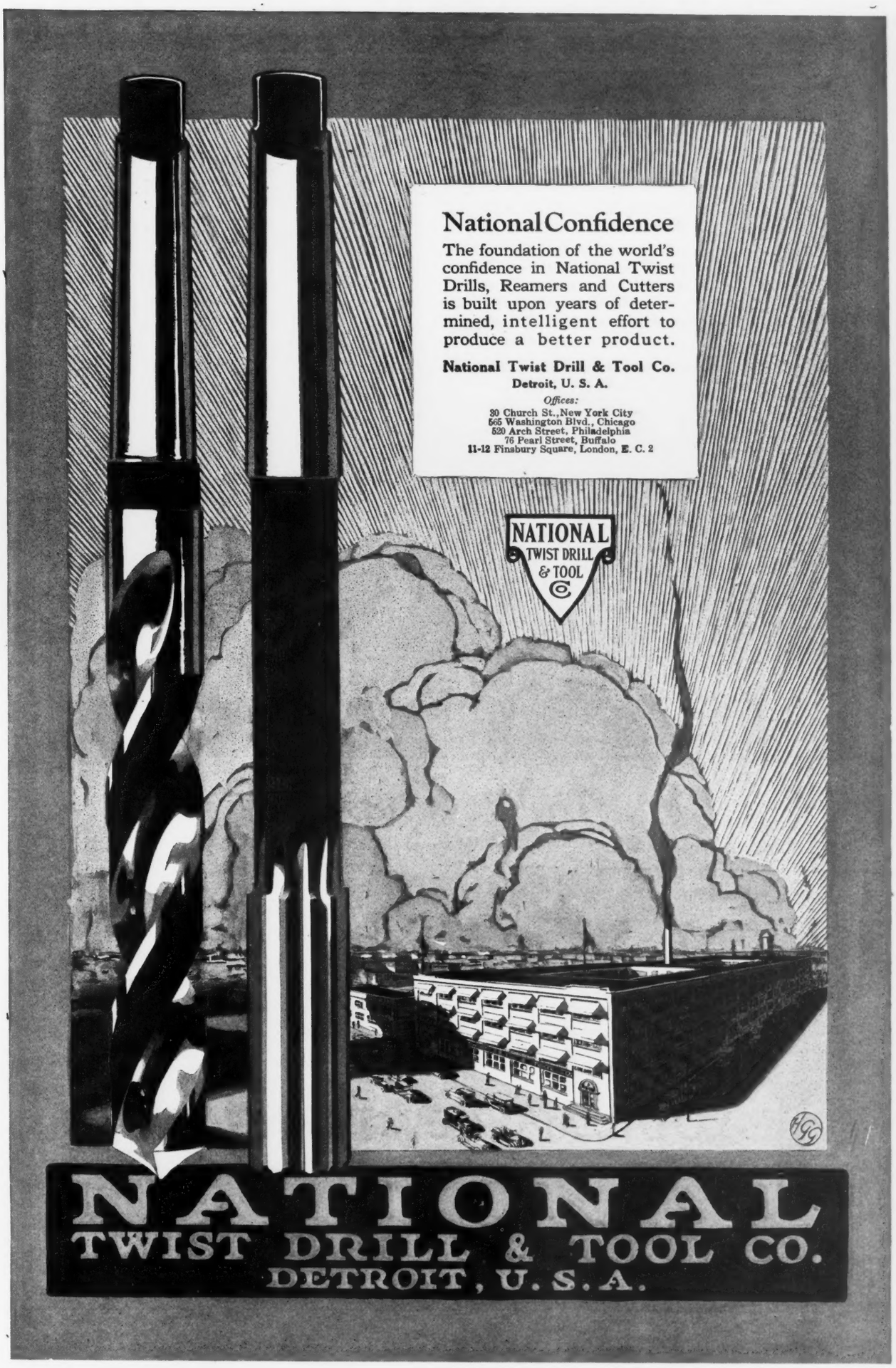
"The operator was able to spend a large portion of his time on other machines, except while cutting the steel pinions with shank, which were cut one at a time, as the shank is larger than the bottom diameter of the gear."

The above testimonial is entirely unsolicited, and, coming from a firm specializing in the cutting of accurate gears, clearly demonstrates the economical advantages of the No. 1 Farwell Gear Hobber. The machine in question was built about ten years ago, and the cost of repairs during that time has been practically nothing.

Write for our Catalogue No. 809, which contains specifications of the various sizes of Farwell Gear Hobbers, with illustrations of the work which they are capable of doing.

THE ADAMS COMPANY, 1901 Market Street
Dubuque, Iowa, U. S. A.

Established 1883


National Confidence
The foundation of the world's confidence in National Twist Drills, Reamers and Cutters is built upon years of determined, intelligent effort to produce a better product.
National Twist Drill & Tool Co.
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520 Arch Street, Philadelphia
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NATIONAL
TWIST DRILL
& TOOL
NATIONAL
TWIST DRILL & TOOL CO.
DETROIT, U. S. A.



Royal Cotton Waste

The Royal Bale

IN the baling, as well as in the making of Royal Cotton Waste, Standardization plays a powerful part. There is a uniform, distinctive character about each compact, durable Royal bale. The Royal Trade Mark on the light clean burlap and the Royal Name on each new steel band complete the identification and definitely assert that "this is indeed Royal—same as before."

Ask your Jobber or us for the Royal Sampling Catalogue and the booklet "Clean Clean Thru."

SMALL USERS SHOULD ASK TO BE SHOWN
THE HANDY NEW ROYAL AUTOPAK BALE





ROYAL MANUFACTURING Co

General Office & Mills
Rahway, N. J.

New York Chicago
Baltimore

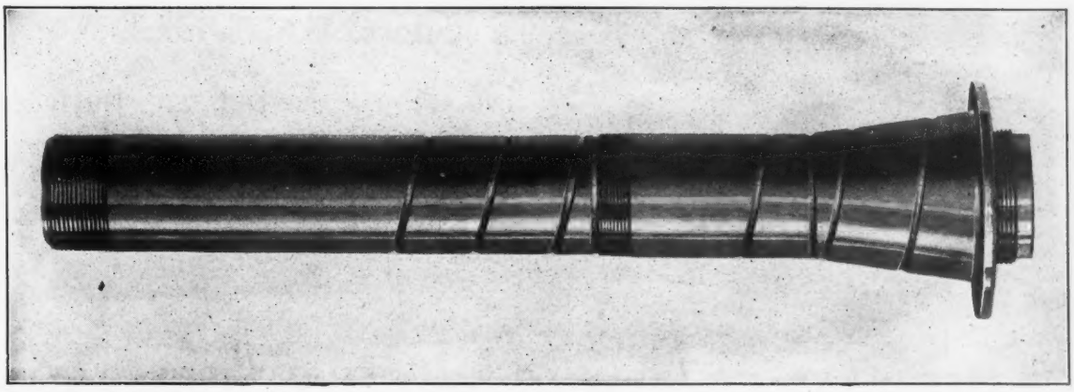
ROYAL COTTON WOOL WASTE
OUR WASTE IS YOUR GAIN

THE GUARANTEE: Uniform Quality 6% Tare (Wrappings) Exact Weight

"It's RADICAL and It's RIGHT"

What?

A Spindle which properly provides for **both** End and Side Thrust.

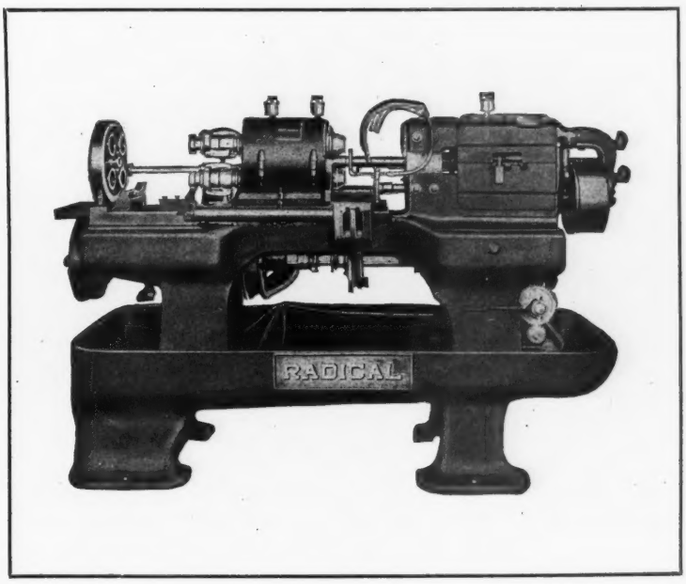


Why?

Because it eliminates frequent adjustments, tends for permanency AND does away with periodical rebushing.

THE

RADICAL



AUTOMATIC

Springfield Automatic Screw Machine Corporation

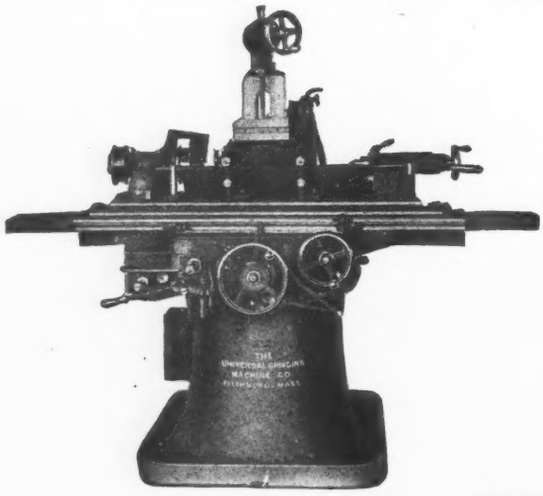
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74 Brush St.
Detroit, Mich.

FITCHBURG, MASS.

Eastern Sales Office:
320 Fifth Ave., Room 912
New York, N. Y.

Bath Universal Grinding Machine

for Cylindrical, Surface, Internal, Tool and Cutter Grinding



MADE IN 3 SIZES

No. 1 10" Swing, 20" between centers, Wheel 10 x ¾

No. 2 10" Swing, 25" between centers, Wheel 12 x 1½

No. 2½ 10" Swing, 36" between centers, Wheel 12 x 1½

BUILT BY

UNIVERSAL GRINDING MACHINE COMPANY

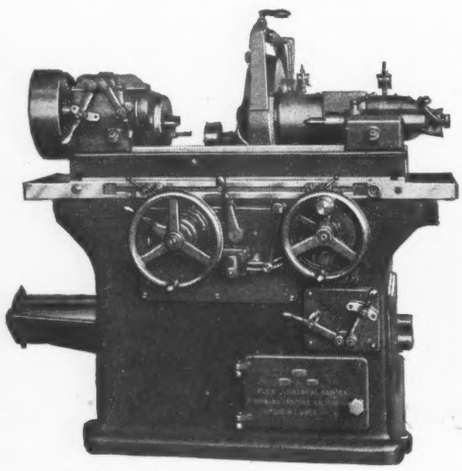
FITCHBURG, MASSACHUSETTS, U.S.A.

AGENTS: The Fairbanks Co., New York City, Albany, Syracuse, Utica, Buffalo, Boston, Hartford, Newark, Philadelphia, Scranton, Baltimore, Birmingham, Ala., New Orleans, Chicago and St. Louis. The Wolverine Mchy. & Supply Co., Detroit. The W. M. Pattison Supply Co., Cleveland. The National Supply Co., Toledo. Laughlin and Barney, Pittsburgh. Brownell Mchy. Co., Providence. Hallidie Machinery Co., Seattle. W. H. Savage, Fitchburg. Alfred Herbert, Ltd., Coventry, Sydney and Yokohama. George E. Fogarty, Paris. Oscar Ericsson, Copenhagen. American Machinery Syndicate, Barcelona, Spain. R. S. Stokvis & Zonen, Holland.

FITCHBURG

MODEL "A" 8 x 20

PLAIN CYLINDRICAL GRINDING MACHINE



CAPACITY:

Centers swing 8" in diameter
Centers take 20" in length
Feeds Automatic.

Specifications

Swivel plate graduated to angle of	10°
Work centers, No. 4 Morse Taper	1¼" dia.
Grinding wheel spindle front bearing	3" dia. 7⅝" long.
Grinding wheel spindle rear bearing	2½" dia. 6½" long.
Grinding wheel spindle pulley	6" dia. 4⅜" face
Size of grinding wheel	16" dia. 1" to 3" face 5" hole
Number of grinding wheel speeds 2	1400 to 1640 R.P.M.
Number of work speeds 6	64 to 340 R.P.M.
Number of table speeds 6	28 to 150 per min.
Tight & Loose pulley on countershaft	10" dia. 4¼" face
Speed of ball bearing countershaft	700 R.P.M.
Floor space at right angles to spindle	52"
Floor space parallel to spindle	83"
Net weight, about	4100 lbs.
Gross weight, crated	4800 lbs.

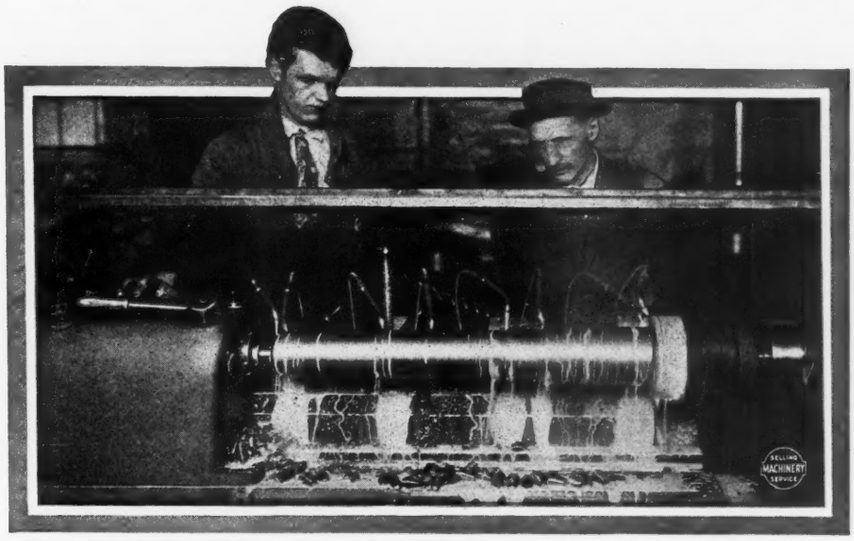
FITCHBURG GRINDING MACHINE CO.

FITCHBURG MASS., U. S. A.

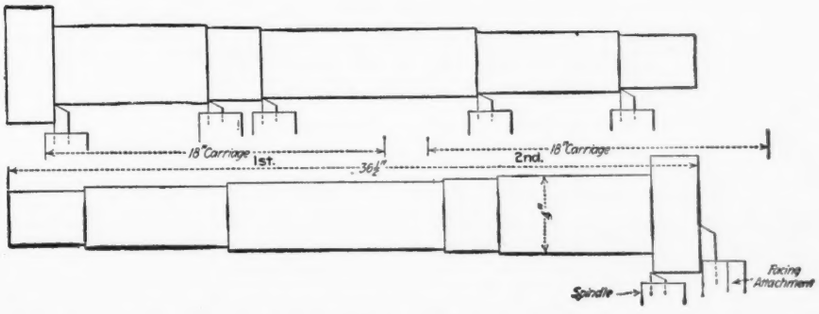
"For the Principle of the Thing" Use the

Lo-swing

MULTIPLE TOOLED LATHE



Turning a Lathe Spindle on the 8" Lo-swing



We hear a lot these days about co-operation — we learn that to attain any object quickly people must combine.

Ten detached units are of little use—ten people concentrating on the accomplishing of a particular object are likely to attain it.

The Lo-swing lathe uses the co-operation principle in turning operations. Instead of utilizing one tool at a time it uses many; the longest individual cut setting the time for the complete job.

Co-operation—it's "the principle of the thing" that counts. Make it count for you. Send for full information today.

Booklet—"The Lo-swing Lathe at Work"—is yours for the asking.

Fitchburg Machine Works, Fitchburg, Mass.



DOWN THE "TRADES"

THE service plan of Prest-O-Lite is more constant than the north-east trade winds—winds which constantly blow and upon which, from the time of the Vikings, navigators have depended for propelling their ships—Also like the "trades" it is wonderfully flexible for

Prest-O-Lite

DISSOLVED ACETYLENE

The Universal Gas with the Universal Service

has a service plan which adapts itself to every fluctuation of the welding and cutting industries—ample for all—yet if only one cylinder of Prest-O-Lite gas is needed the service functions as efficiently.

You will be interested in the facilities of our 40 plants and warehouses—Ask us for all details.

THE PREST-O-LITE COMPANY, Inc.,

General Office, 30 East 42nd St., New York

Kohl Building, San Francisco

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PW-504

AJAX

(Trade Mark Registered)

HOT METAL WORKING MACHINES

Forging Machine Protection

Ajax New Model Twin-Geared Upsetting Forging Machine

An increase in the life of a machine and decrease in necessary repairs are dollars in the pocket of the owner. Accordingly, in our effort to develop the full mechanical possibilities of the Forging Machine in our new model, we have also given much study to improving the wearing qualities of its parts.

Wearing areas have been enlarged and parts subjected to greatest strains much strengthened.

Improvements in design of parts were likewise effected as instanced by the new type of Header and Die Slides. As shown by figures 1 and 2, they are of overhung top suspended type, eliminating the bottom bearing. The sliding surface transferred to the lips which are bronze faced, and are to a very large extent, out of the range of scale and rust, which collected on the bottom bearings of the old model slide and caused excessive wear.

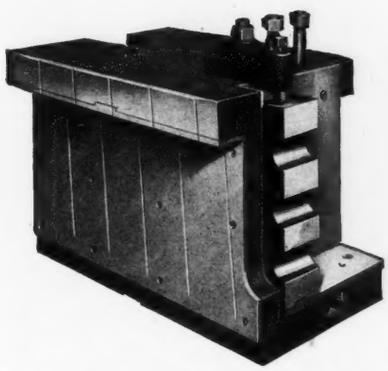


Fig. 1. Die slide showing overhanging support and bronze bearing surface.

Figure 3 is a longitudinal sectional drawing through the center of the machine, and shows the various working parts of the NEW MODEL Ajax Twin Geared Upsetters. As may be seen, there are no bottom bearings—a clear space is visible under both header and die slides.

The sliding surfaces are faced with the best bearing bronze. Ample oil grooves make uniform lubrication. Write for our descriptive book.

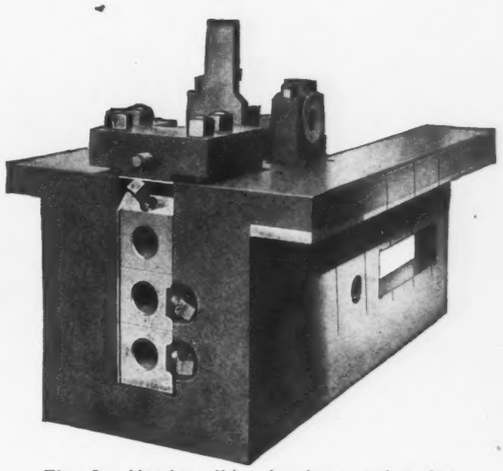
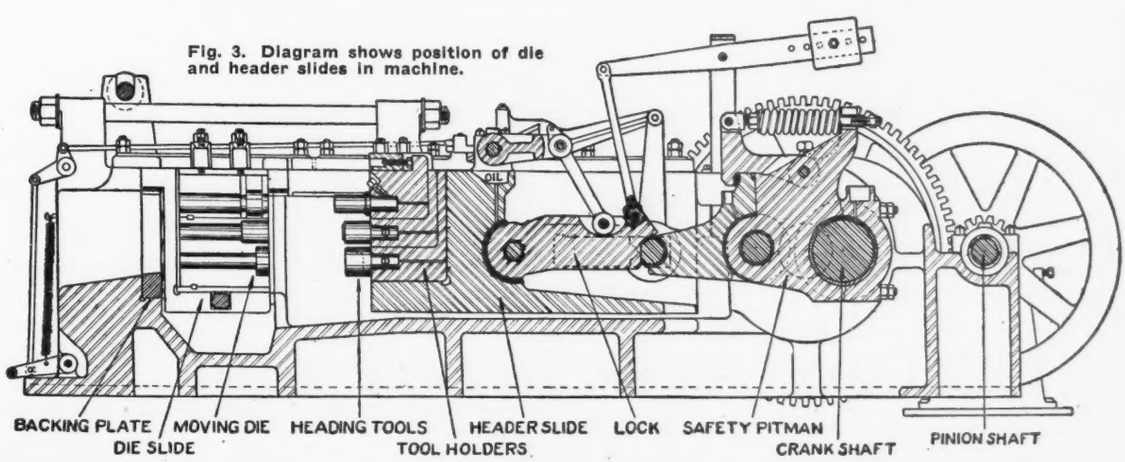


Fig. 2. Header slide showing overhanging bronze bearing and oil grooves.

Fig. 3. Diagram shows position of die and header slides in machine.



THE AJAX MANUFACTURING CO.

621 Marquette Building
CHICAGO, ILL.

CLEVELAND, OHIO

1369 Hudson Terminal
NEW YORK CITY



ALLOY STEEL SCREWS

The efficiency and life of a lathe dog or a clamp depend largely upon the quality of the screw.

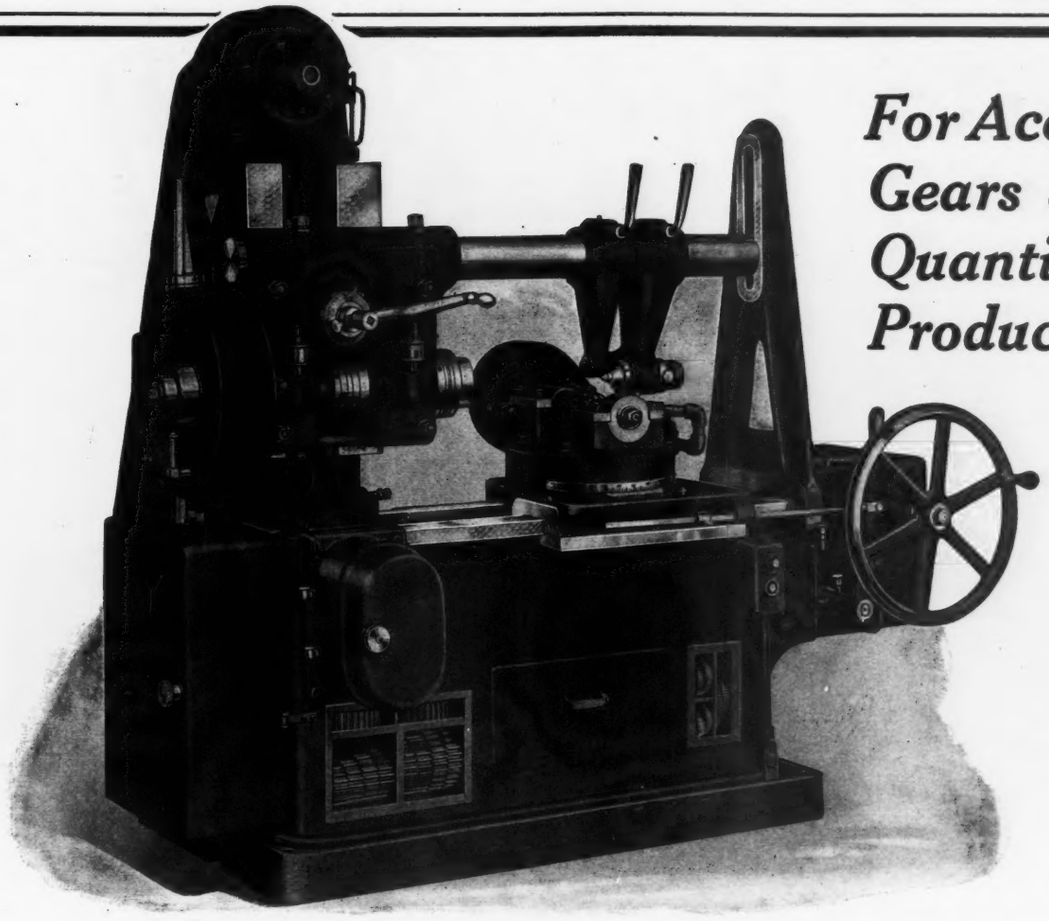
We make the screws used in our dogs and clamps from a special chrome-nickel steel; they are given a special treatment and the points are hardened. They are practically unbreakable and will outwear soft steel or casehardened screws ten to one. These extra quality screws and their superior design and workmanship have earned for Armstrong Dogs and Clamps a preference based upon actual service. All kinds and sizes in stock.

Specify Armstrong when ordering and get the best

Catalog mailed free upon request

ARMSTRONG BROS. TOOL CO.
"THE TOOL HOLDER PEOPLE"
313 N. FRANCISCO AVE. CHICAGO, U.S.A.

CINCINNATI
16-INCH GEAR HOBBERS



For Accurate Gears and Quantity Production

Cincinnati 16″ Hobbers are designed to meet the essential requirements of strength, accuracy, speed and convenience of operation.

The weight of the machine, 5600 lbs., is an indication of its strength and rigidity, the extra metal being accounted for by the very generous dimensions throughout, and being so distributed as to provide the greatest stiffness possible. This contributes to the accuracy of the machine, and means not only increased life of the machine itself, but more important still, additional life for the hobs.

The strength of the hobber is transmitted directly to the hob, reducing the tendency to chatter to a minimum, and materially prolonging the life of the cutter. This is a real economy, particularly when working extremely hard metals.

For quantity production it has become the recognized and accepted means of cutting spur and spiral gears and splining shafts. It can be applied with equal facility to the cutting of ratchets and sprockets.

This is only one of the Cincinnati line—we have a size for every need.

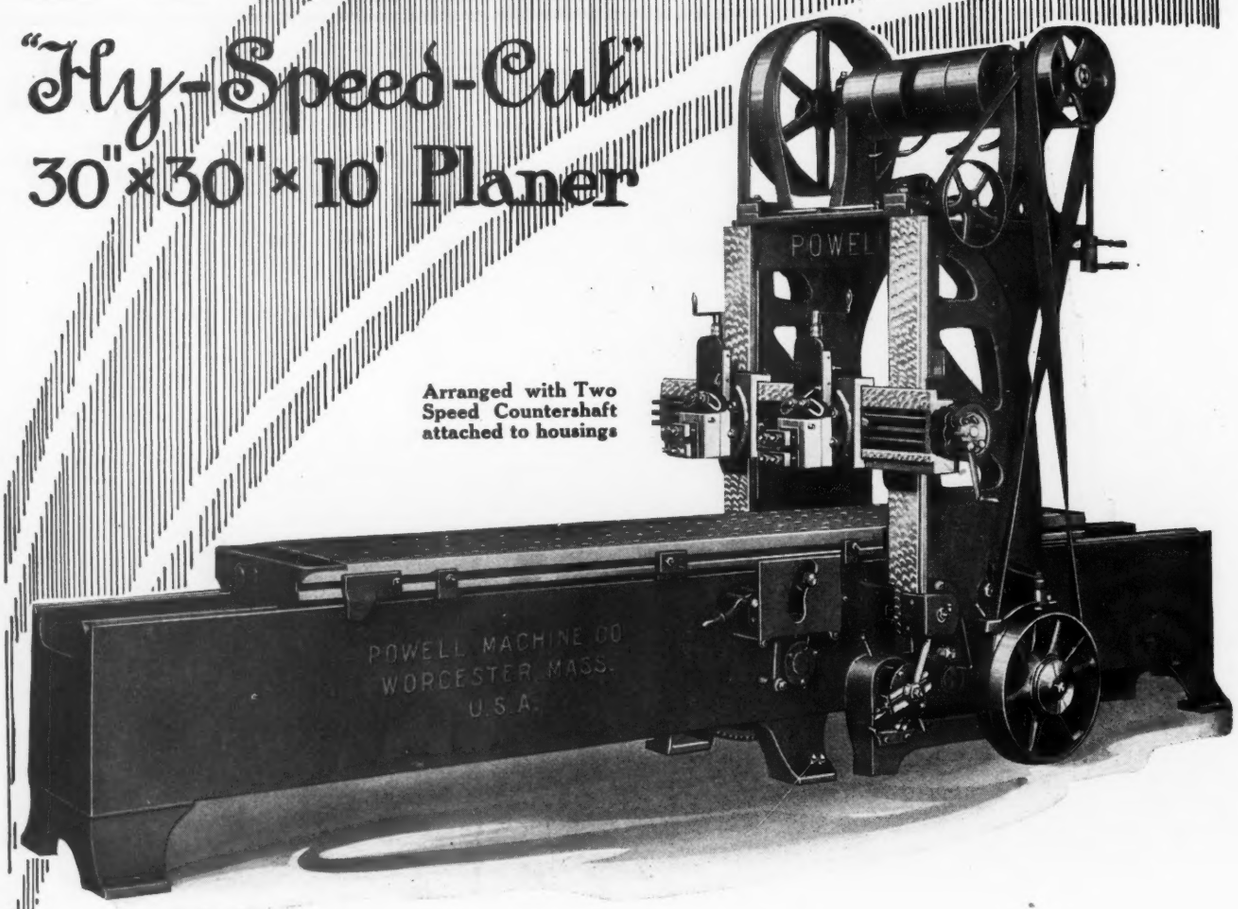
THE CINCINNATI GEAR CUTTING MACHINE COMPANY

(Subsidiary of The Cincinnati Shaper Co.)

CINCINNATI OHIO, U. S. A.

Powell

"Fly-Speed-Cut"
30"×30"×10' Planer



Arranged with Two Speed Countershaft attached to housings

Increases Cutting Speed or Checks It at will

The Powell Planer mechanically increases its initial cutting speed after the tool enters the cut. Retards to initial speed before reaching the end of the cut, absorbing shock of reversing at high speed. It jumps the open spaces at high speed. Operates at standard cut or accelerating cut. Choose your speed—vary it at will. The Powell takes 31 inches between housings and 31 inches under cross-rail. Roughs out and finishes cast iron at from 40 to 120 feet per 60 seconds, and steel at 30 to 180 feet in same time.

Write today for complete data.

POWELL MACHINE COMPANY

Sole Builders

245 Stafford Street **Worcester, Mass., U. S. A.**

LAPOINTE
BROACHING MACHINES

Simplify the Difficulties of Accurate Duplication

The increase in "interchangeable manufacture" in all classes of machines presents a growing necessity for the accurate duplication of difficult operations at a commercially possible price.

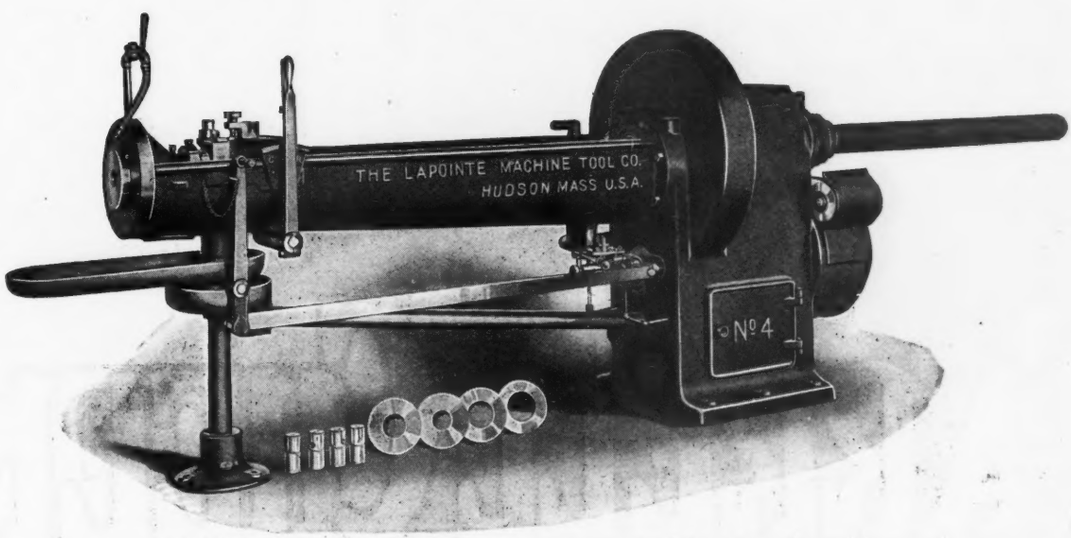
The problem of economically cutting odd-shaped holes in metal parts—long a stumbling block in the development of machinery—has been solved in many cases by Lapointe Broaching.

The simplicity of the operating principle of Lapointe Broaching Machines enables semi-skilled workers to operate them efficiently. The accuracy and speed of production in all metals, coupled with low operating costs, have made them a valuable factor in the development and manufacture of all kinds of machinery.

Manufacturers should know the cost-cutting possibilities of Lapointe Broaching on work now in their shops.

Designers *must* know the possibilities they open for improving the design and developing new machines.

Our engineers are here to show you whether *your* work looks possible or not. Put your problems up to them—and find out what Lapointe Broaching Machines can do.

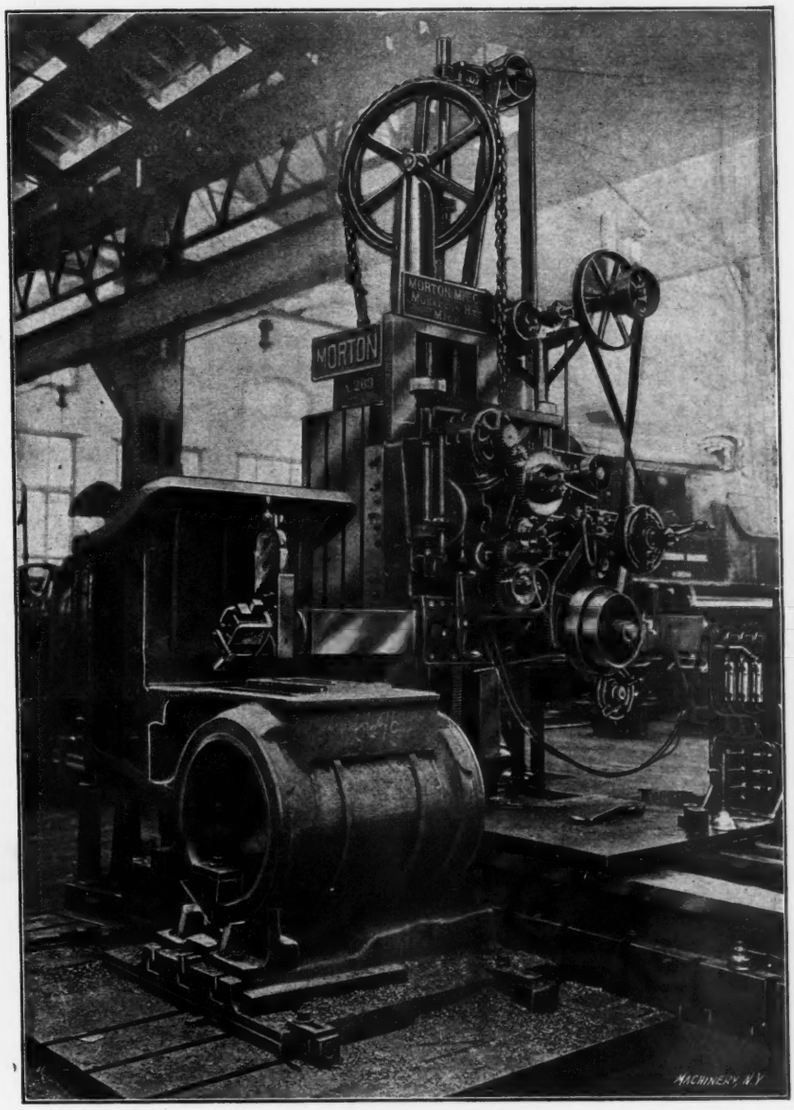


THE LAPOINTE MACHINE TOOL CO.
HUDSON MASSACHUSETTS, U. S. A.

FOREIGN AGENTS: Burton, Griffiths & Co., Ltd., British Isles. Allied Machinery Co., South America, Russia and Balkan States, Belgium, Holland, Switzerland, Australia, New Zealand and Tasmania. Alfred Herbert, Ltd., France, Italy, Spain, Portugal and Japan. V. Lowener, Scandinavia. F. G. Kretschmer & Co., Germany and Austria. Andersen Meyers Co., Shanghai, China.


Do you buy
Steel Castings
or
Farrell-Cheek
Steel Castings
There is a definite difference which is recognized by a large per cent of the world's leading manufacturers.
This difference begins with the analysis of your blue prints and follows the casting throughout its making.
It is not a matter of so many blue prints specifying steel, alloy, etc., poured into such and such mould—and cleaned up to look pretty good.
This difference results from the vital interest of every skilled man in laboratory and foundry. Each order is treated as an individual problem which gives them a chance to demonstrate their master craftsmanship. Each man has a pride in his own accomplishment and the result of that united effort and personal interest cannot fail to produce a uniform, homogeneous casting true in every respect to specification.
Castings we are proud to make
Castings you are glad to take
Let us show you results on your next order.
Farrell-Cheek Steel
Foundry Co.
"Makers of steel castings that are a little better than the next best."
Sandusky, Ohio
STAFF
FARRELL-CHEEK
F-C

The Morton Draw-cut Traveling Head Planer



Saves Three-Fourths of the Power Bill

One of the many points of superiority which the Morton Draw-cut Traveling Head Planer has over the ordinary housed planer is the great saving it makes in your power bill.

Operating on one-fourth the power necessary for a housed planer of equal capacity, it leaves the remaining three-fourths available for other uses. The power, in the case of the Morton, is used to *machine;* only an insignificant fraction being absorbed by friction, etc. In the case of a small job on an ordinary housed planer it sometimes happens that more power is wasted in reciprocating the parts of the machine than is used on the work.

Then there is none of the vibration and chatter so marked when taking heavy cuts in "difficult" metals with an ordinary planer.

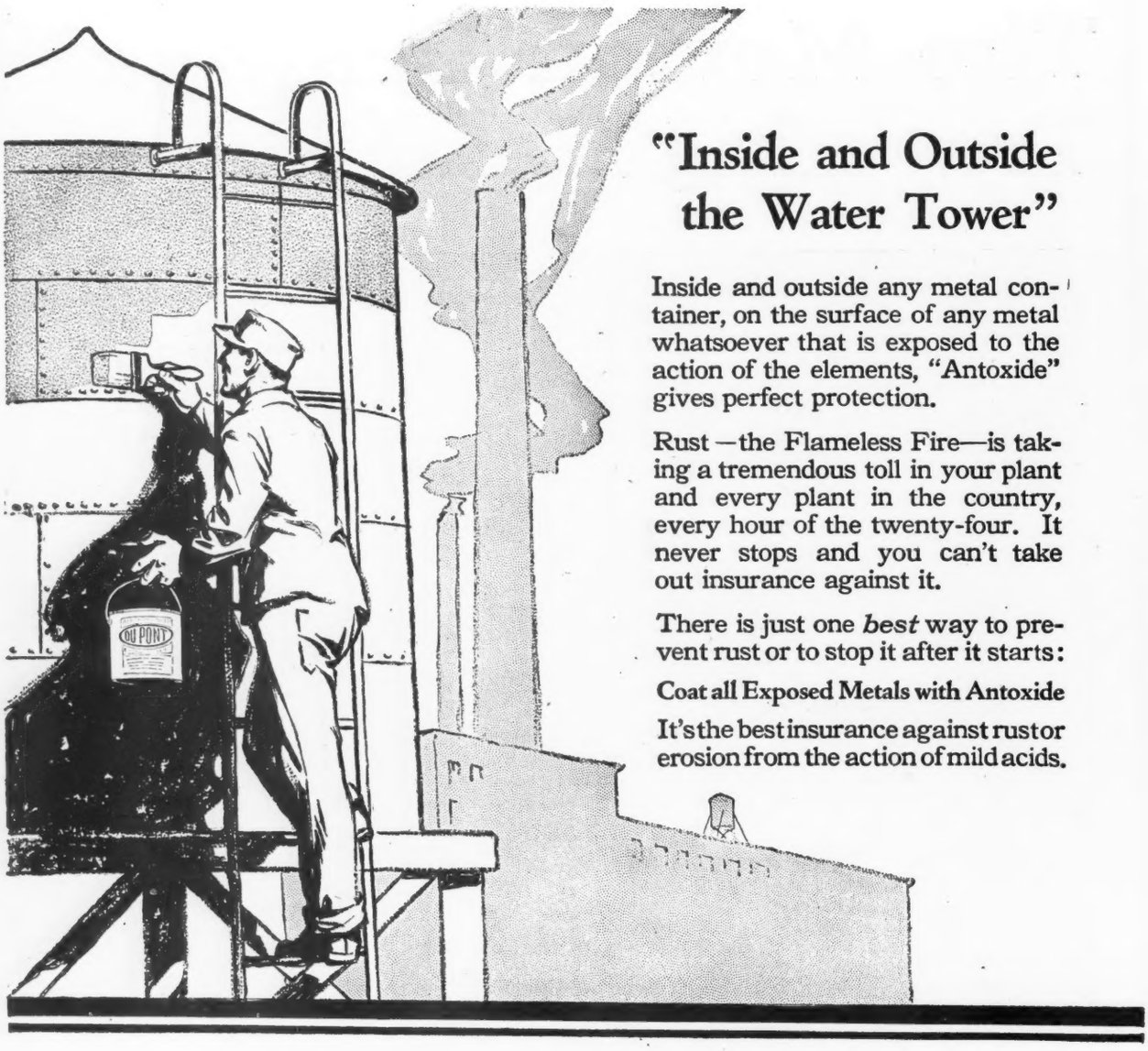
The traveling head enables operator to machine practically every part of even the most awkward casting without the necessity of resetting.

The Morton not only planes; it bores, mills, and performs a multitude of machining operations which might otherwise necessitate the installation of several machines. It will greatly extend the scope of your plant.

Send for Bulletin 8-D and find out all about the Morton Draw-cut Planer.

MORTON MANUFACTURING CO.

MUSKEGON HEIGHTS MICHIGAN, U. S. A.



"Inside and Outside the Water Tower"

Inside and outside any metal container, on the surface of any metal whatsoever that is exposed to the action of the elements, "Antoxide" gives perfect protection.

Rust—the Flameless Fire—is taking a tremendous toll in your plant and every plant in the country, every hour of the twenty-four. It never stops and you can't take out insurance against it.

There is just one *best* way to prevent rust or to stop it after it starts:

Coat all Exposed Metals with Antoxide

It's the best insurance against rust or erosion from the action of mild acids.

Antoxide—a Wonderful Product

—*a Du Pont Product*

The Du Pont name came to be a factor in American Business in 1802—118 years ago—and in that period it has come to mean just one thing—leadership.

"Antoxide" will do precisely what we claim for it—and more—because it has been designed to perform certain functions and tested in every conceivable manner to see that it does—in our own Research Laboratories where we employ the largest staff of chemists in the country.

The Du Pont Label is the guarantee of a superior product—the kind it will pay you to buy.

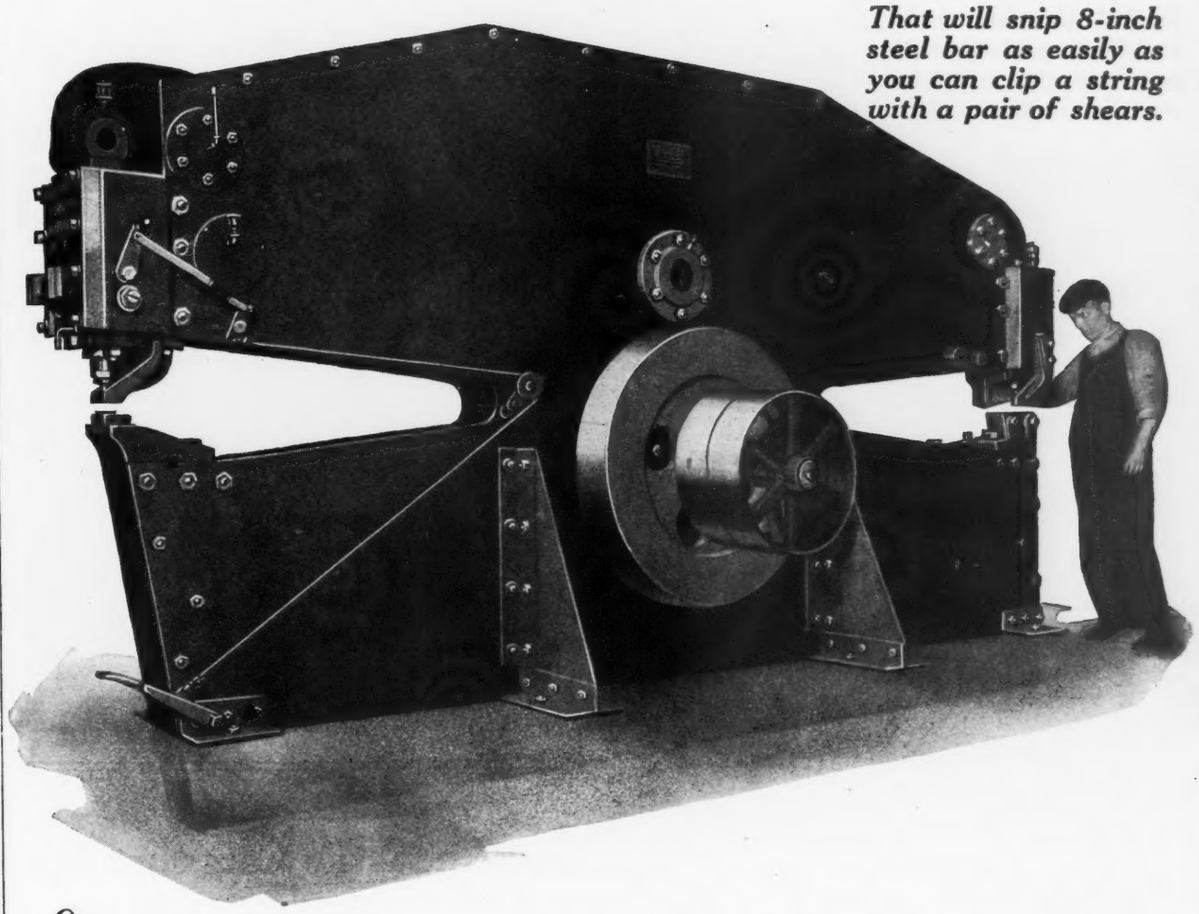


E. I. du Pont de Nemours & Company, Inc.
Sales Dept.: Paint and Varnish Division
WILMINGTON, DELAWARE

DU PONT ANTOXIDE

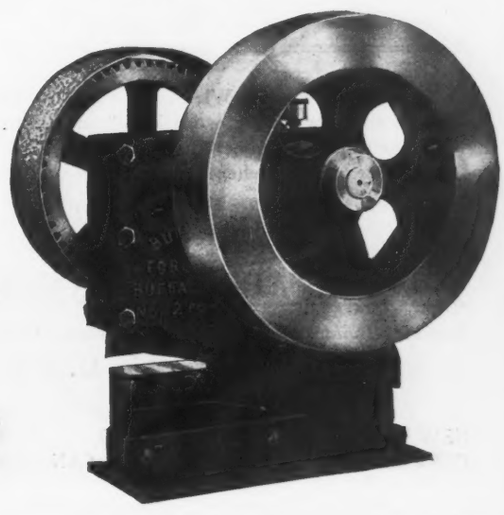
This Big Powerful Brute

That will snip 8-inch steel bar as easily as you can clip a string with a pair of shears.



Or

the little baby power shear that stands only 25 inches—the smallest power shear made—are two of an almost unlimited line of Buffalo Armor Plate Punches for Shears and Bar Cutters built for every purpose—hand or power. Armor Plate has a tensile strength of 75,000 lbs. per square inch—practically unbreakable. These machines are less than 1/3 as heavy as cast-iron machines of equal capacity.



"Buffalo"

Write for Catalog P-S
Dept. 51

BUFFALO FORGE COMPANY
Buffalo, N. Y.





Here is a Disteel Wheel demounted. Disteel is the new magic word in automobile manufacture. This steel disk wheel is replacing other types of wheels on many makes of cars.

You Know the Cars that Use DISTEEL WHEELS

Well, Here's the Press that Forms Them

Here's the thousand-ton Hydraulic Forming Press shaping the disks for Disteel automobile wheels. The operation (second in making the disks) includes flattening the hub section and sizing the center hole to 4.135″—production is 1,000 pieces per nine-hour day. The press is seven years old and is still on the job in the plant of the Detroit Pressed Steel Company.

There are Hydralic Presses for every requirement. Submit your specifications; our engineering staff is here to advise you on hydraulic work in any department or line.

We are engineers—builders of hydraulic machinery exclusively; write us today, while you have the matter in mind.

THE HYDRAULIC PRESS MFG. CO.

Engineer-Builders of Hydraulic Machinery Exclusively

Mount Gilead, Ohio, U. S. A.

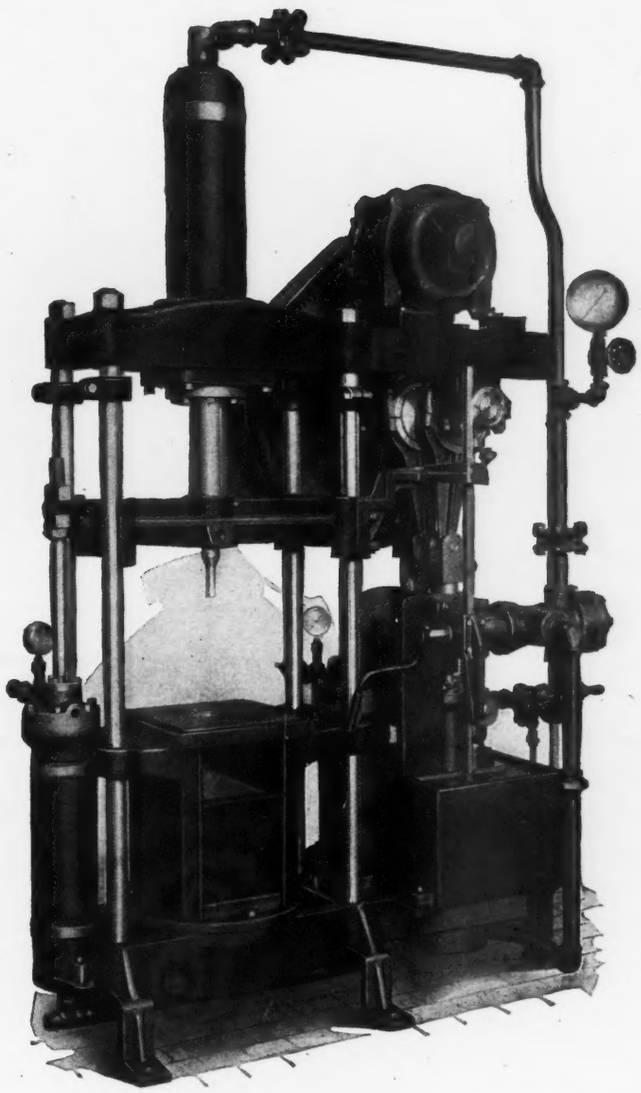
NEW YORK CITY BUFFALO DETROIT
CLEVELAND SAN FRANCISCO

"METALWOOD"

No. 350 High Speed Vertical Broaching Press

Ten 15" Work Strokes per Minute

Maximum Stroke 18"



Constant pneumatic pressure "push-back" cylinders adjusted to absorb shock of return stroke

"Originality is characteristic always of Metalwood Designs and Developments"

METALWOOD MANUFACTURING COMPANY

HIGH SPEED HYDRAULIC AND HYDRO-PNEUMATIC MACHINERY

DETROIT MICH.

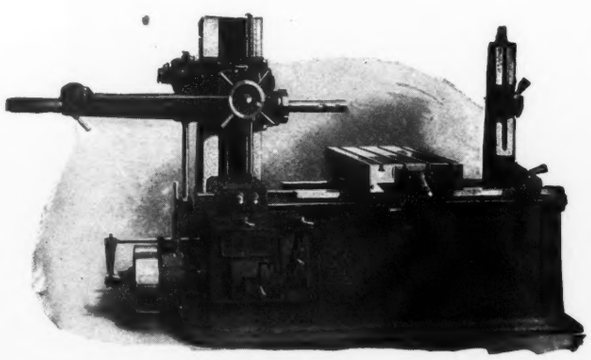
Versatility

CLEVELAND HORIZONTAL BORING, DRILLING AND MILLING MACHINES are adaptable to and will effectively, efficiently handle a varied assortment of work. Shopmen daily find new uses—new operations—which the machine handles advantageously.

Perhaps you are paying for a "CLEVELAND" without having the use of it. Better write for the circular right now—before you forget.

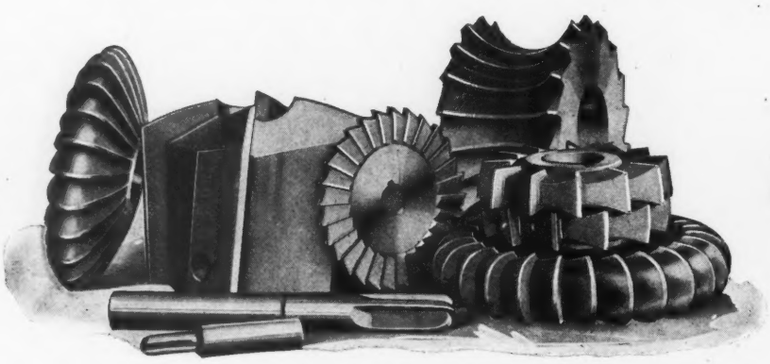
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J. Horstmann, Paris, France.
Mayer & Lage, Inc., 120 Broadway, N. Y. For Siberia and Japan.

DOMESTIC AGENTS:
E. L. Essley Machinery Co., Chicago, Ill.
J. S. Miller Machinery Co., Pittsburgh, Pa.
D. Nast Machinery Co., Philadelphia, Pa.
Purinton & Smith, Hartford, Conn.
Brownell Machinery Co., Providence, R. I.
Marshall & Huschart Machinery Co. of Indiana, Indianapolis, Indiana.
O. R. Adams, Rochester, N. Y.



The Cleveland Machine Tool Co.
3221 Superior Ave. Cleveland, Ohio
Established 1907

S. C. CUTTERS



have made a reputation of accomplishing difficult tasks, which others said "could not be done." If you have a difficult cutter problem put the solution up to S. C. Engineers. Immediate delivery can be made of the usual sizes of standard cutters.

Your inquires will receive prompt attention.

THE SHIELDS CUTTER COMPANY
formerly The Cleveland Milling Machine Company
CLEVELAND, OHIO, U. S. A.
NEW YORK PITTSBURGH DETROIT

CLEVELAND

Open-side Planers

Planing Heavy Castings to Suit Exacting Customers

It takes good tools to do good work and the working equipment of big plants may be judged by the quality of their products. That this photograph of a Cleveland Open-side Planer was taken in the Johnston & Jennings (Cleveland) Plant lends added interest to the work shown.

There are three Cleveland Open-side Planers in the machining department of this big modern plant; an important part of the "behind the scenes" equipment that makes possible the high quality of work that is turned out. The hoisting machine base in operation weighs 3 tons—a bulky piece that would be difficult to set up on any other type of machine.

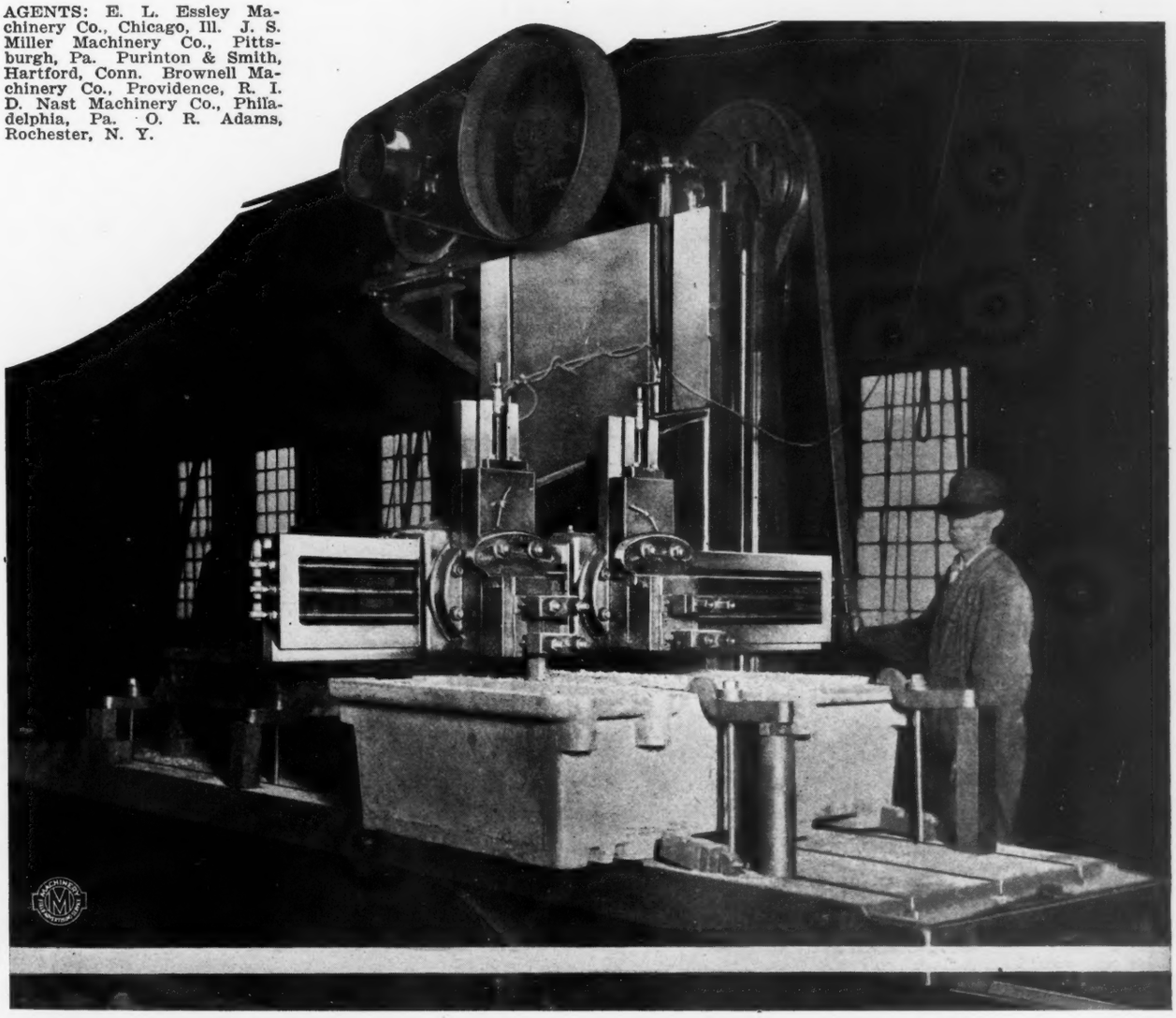
Wide range, heavy construction and extremely simple operation enable Cleveland Open-side Planers to handle all classes of work accurately and economically; their fundamental feature, the "Open-side" construction, makes it possible to take extremely wide work without difficulty. Built in sizes to take 26″ to 72″ beneath the cross rail. May we send you further details?

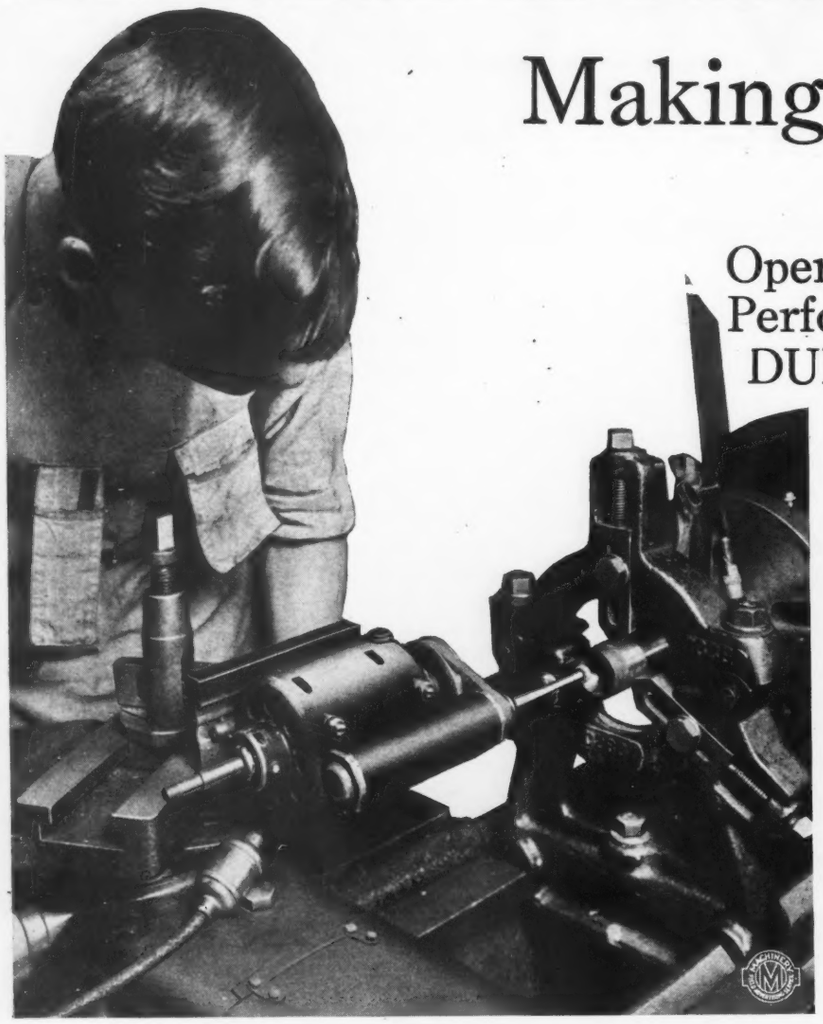
THE CLEVELAND PLANER COMPANY

Established 1900

3152 Superior Avenue **CLEVELAND, OHIO, U. S. A.**

AGENTS: E. L. Essley Machinery Co., Chicago, Ill. J. S. Miller Machinery Co., Pittsburgh, Pa. Purinton & Smith, Hartford, Conn. Brownell Machinery Co., Providence, R. I. D. Nast Machinery Co., Philadelphia, Pa. O. R. Adams, Rochester, N. Y.





Making Fine Tools

An Interesting Operation, Economically Performed by Means of a DUMORE GRINDER

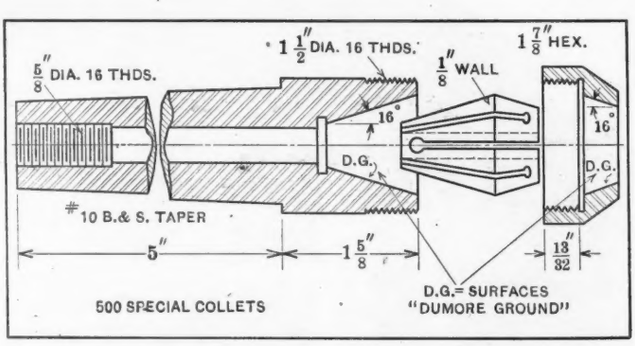
This photograph—taken at the City Engineering Company's (Dayton, Ohio) plant shows a Dumore Grinder finishing the main shank and head of a special draw-in collet. There were 500 put through in this special lot and the time for the operation shown averaged 8 minutes per piece.

The second operation, grinding the internal face of the collet nut, was also performed by this convenient precision tool.

Dumore Grinders are popular here as in every plant where fine tools are made. Their accuracy makes them useful for the finest finishing work; their simplicity and convenience make them practical for many difficult, almost inaccessible jobs.

Dumore Grinders transform any lathe into a precision grinder; they make fine finishing possible in every machine shop.

May we tell you more about them?



WISCONSIN ELECTRIC COMPANY

2526 Sixteenth Street RACINE, WISCONSIN

DUMORE

Dumore Grinders for Finishing to Close Limits

Accurate, Adjustable, Easily Attached and Adjusted



HIGH SPEED GRINDERS



Forging Eyes on Brake Hangers

on the

NATIONAL

Heavy-Pattern Forging Machine

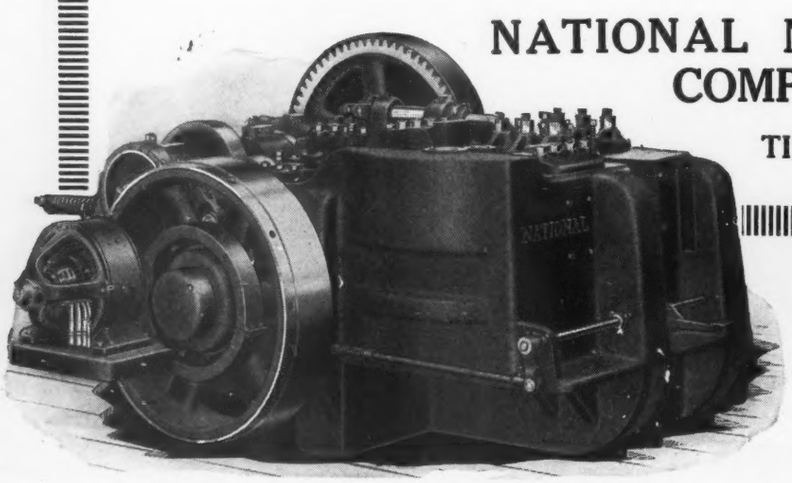
Generally this "eye" is completed under the Hammer, or flattened and punched by standing vertically in front of the heading ram of the Forging Machine.

In the National, the flattening and punching operations are effected by the side dies, making the job quicker and more economical.

The powerful side grip of the National simplifies and makes possible many forging jobs of this character, increasing the range of the machine and your profits as well.

Will be glad to look over your prints.

For details of the above job and dies ask for National Forging Machine Talk No. 36.



NATIONAL MACHINERY COMPANY

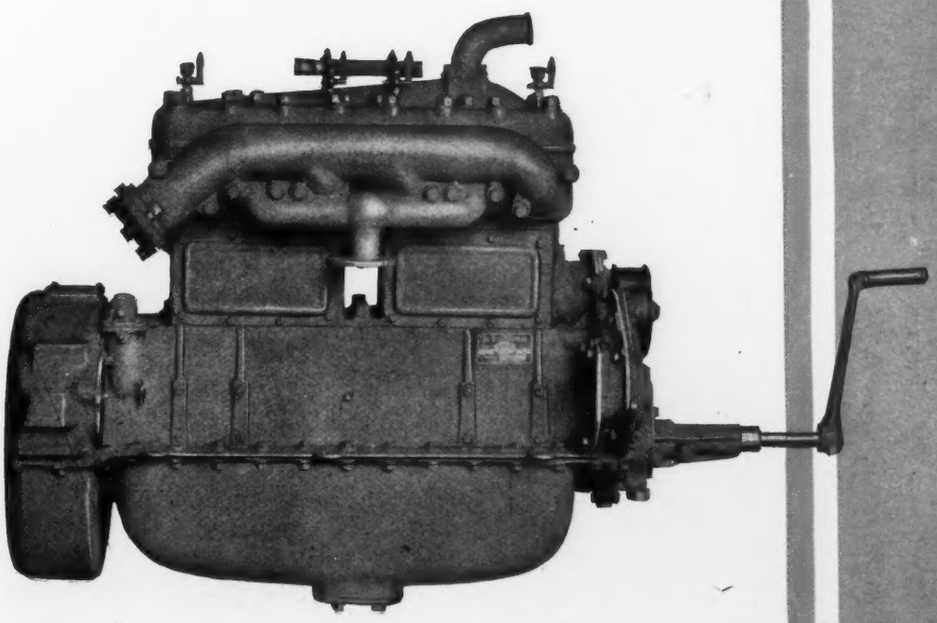
TIFFIN, OHIO, U.S.A.

ARE YOU RECEIVING NATIONAL FORGING MACHINE TALKS?

The Grinding Wheel *and* The Gasoline Engine

How Grinding has Made Possible the Twentieth Century Power Unit

BUDA FARM ENGINE

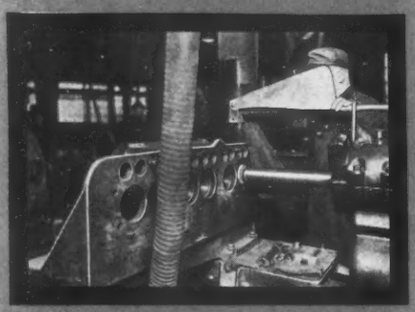


TRADE NORTON MARK

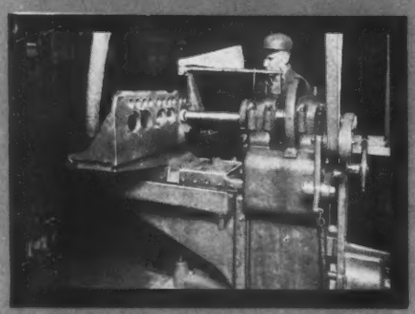
Grinding Is More Than an Economic Factor in the Production of the Gasoline Engine—It is a Fundamental Process Upon Which Design Is Based



Grinding Cylinder Castings, Heald Machines.



Limits are plus or minus .001"; stock removed .008" to .012"



Wheels are Norton Crystolon, 24-J, 3½" x¾"x¼"

Time was when the most advanced idea of grinding was to mount a grindstone on a wooden horse in a corner of the shop for the touching up of a tool, perhaps, which was rubbed up against the wheel revolved by foot power and roughly made as fit as any operator desired or imagined necessary. A little later human power was eliminated and the grindstone was hitched up to a belt, thus bringing into existence a primitive type of grinding machine.

Then came a period of constant advancement in grinding means and methods. Knack gave way to science; crude makeshifts fell down before intricate machines of efficiency, and grinding work was produced with speed and accuracy.

Grinding goes hand in hand with modern invention. The requirements of speed, endurance and compactness, prescribe accuracy in machining the parts of a mechanism—and the practical science of grinding has so kept pace with imaginative genius of the inventive minds of the period that the niceties of perfect fitting and perfect running parts which formerly dwelt in the mind of the theorist have been brought into actual existence.

That invention which seems to best typify twentieth century American progress is the gasoline engine, for its use is so general as to have practically put it ahead, as a factor in transportation, of the nineteenth century marvel propelled by steam. The gasoline engine is the motive power of the automobile, the aeroplane, the cycle, the launch, the tractor—in fact of every kind of modern means for doing work and

TRADE NORTON MARK

effecting transportation. And it is not radical to state that grinding science is responsible for the remarkable development of this power unit which has revolutionized industry, transportation, thought, and modern life; FOR THERE ARE FEW PARTS OF GASOLINE ENGINES WHICH ARE NOT GROUND. The Middle West is the home of the automobile industry and here, side by side, is to be found the companion industry for the manufacture of gasoline engines. At the Buda Company, Harvey, Illinois, the Norton grinding wheel, machine, and methods make up a large part of the equipment for the transforming of metal into the complexities of the rapid, accurate working of the Buda engine.



Grinding Pistons; Norton Machines; Norton Wheels, Alundum 24 Combination L18"x2½"x5"

The gas engine builder and the well-informed mechanical man to whom the inner workings of his automobile engine are no enigma, are naturally interested in the operations which make the engine possible. What grinding did for the evolution of the gasoline engine can be summarized in a recounting of the grinding operations as they are carried on at the Buda plant.

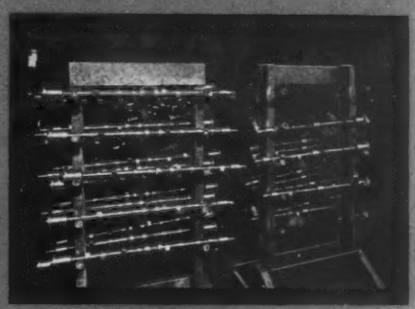


Pistons are Gray Iron, 4½" x 5⅜". .030" stock is removed, output 300 per day.

Cylinder Grinding

The cylinder is the fundamental of the engine and in the proper grinding of this part lies the efficiency of the larger me-

Camshafts are rough ground with Norton Alundum Wheels, 24-Q 18"x1¾"x5" and finish ground with a Norton Alundum 24-L 18" x 1¾" x 5" wheel.



Gifford-Wood Company—Ice Cutting Machine, Buda Engine.



TRADE NORTON MARK



Testing Concentricity of Crankshaft with Dial Gauge.

chanical structure. Buda cylinders are cast four en bloc and are ground in this plant on Heald Cylinder Grinders equipped with Crystolon wheels 24-J, 3½" x ¾" x 1¼". The cylinders come from the Boring Department with from .008" to .012" stock left on the diameter to be ground. The limits are plus or minus .001". Each machine completes twelve castings in an eight-hour day, a total of 48 cylinders.

Piston Grinding

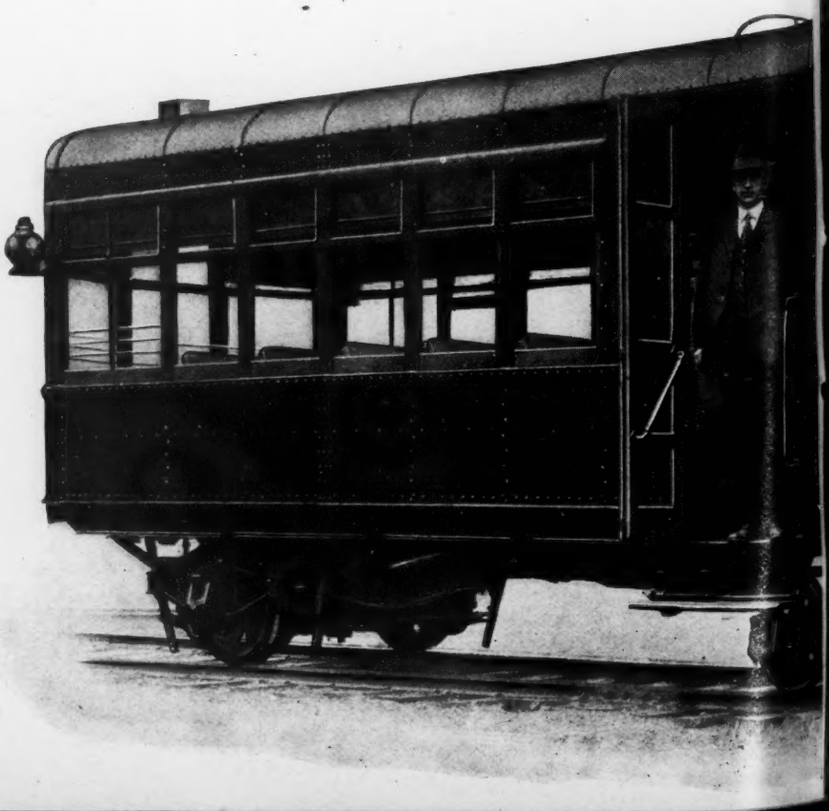
In the grinding of the pistons is again exhibited the advantage of this modern method of machinery for effecting nicety of fit and the consequent gain toward the perfect running of the motor. Although the piston grinding department of the Buda plant is not large, the operation is interesting and has been developed to a point of high efficiency. The pistons come rough-turned from the lathes about .030" oversize and are ground down to within limits of plus or minus .0005" on a Norton grinding machine employing Alundum wheels 24 combination L, 18" x 2½" x 5". The output is 300 in an eight-hour day and three machines easily handle the work. In setting up the pistons, one end is centered and a cap having a center hole,



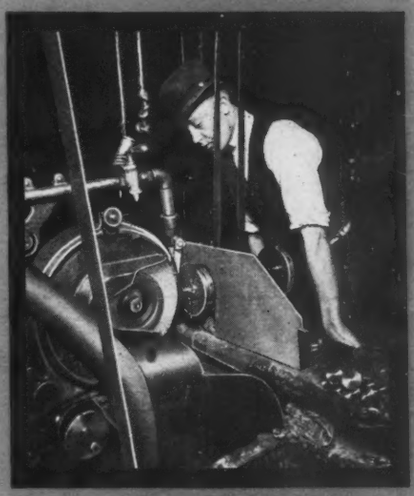
Looking into the grinding wheel storeroom. "Buda" carries a big stock of Norton Wheels.



Crankshafts, Rough and Finish Ground, both Main Bearings and Crank Pins.



is fitted over the open end of the piston, the cap being held in by a dummy wrist pin which goes through the piston and the shank of the cap, thus enabling the pistons to be ground on center.



Rough Grinding Valve Heads, Norton Machine, Norton Alundum Wheel 24-M, 20"x2"x12½"

Connecting Rod Bushings

Grinding follows all along in the story of the Buda engine. The upper connecting rod bushing, which is of cast bronze, is bored, reamed, and faced on one end in a screw machine, but no turning or finishing is done on the outside diameter. The bushings are placed on a lathe arbor and are ground down to 1.314" with a grinding limit of plus or minus .0005". These bushings are a press fit in the connecting rods. Formerly there was an intermediate operation of rough turning to within .015" or .020" of size on the screw machine, but now *they are ground directly to size from the rough.* It can be readily seen that a great saving was brought about by eliminating this turning operation on the outside diameter. From ⅛" to 3/16" of stock is removed in grinding and production is 600 in eight hours. A Norton 24 combination M, 20" x 4" x 12½", wheel is used and a perfect surface is attained on the bushing.



Finish Grinding Valve heads, Norton Machine, Norton Alundum Wheel 24-M, 20"x2"x12½"

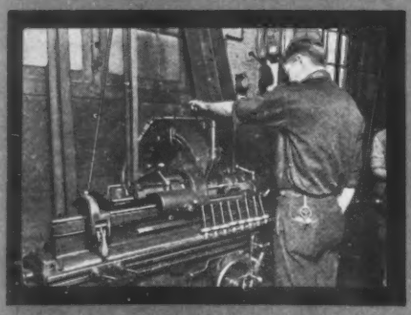


Placing Push Rods into Collets for Grinding Shanks.



Bowen Motor Railways Corporation—Passenger Car, Buda Engine.





Grinding Push Rod Shanks, Norton Wheels, 24 combination M, 20"x4"x 12½"

Crankshaft Bearings

Grinding the crankshaft bearings is an important operation. Two Norton grinding machines are used for roughing and two for finishing. On the roughing operation, .060" of stock is removed from the center bearing and .045" is removed from the rear and front bearing, leaving .005" to .008" of stock for finishing. The wheels used on these operations are originally 26" in diameter and are employed for grinding the crankpins. When they have worn down to 22" in diameter, they are sent over to the bearing grinding machines where they are finished out.



Valve Push Rods are Ground on Centers, Center Plugs being Screwed into the Tapped End. The Flange End Goes into a Screw Collet.

After the crankshafts are ground, a sclerescopic reading is taken which must show a point between 41 and 45. Any crankshaft which varies more than .001" in concentricity is rejected. In the grinding of these crankshafts much attention is given, and at the same time a very good production is maintained. Roughing is accomplished at the rate of 55 per eight-hour day, and about 58 are turned out in the finishing operation in the same time.



Grinding Connecting Rod Bushings, Norton Wheel 24 combination M, 20"x4"x 12½"

Crankshaft Pins

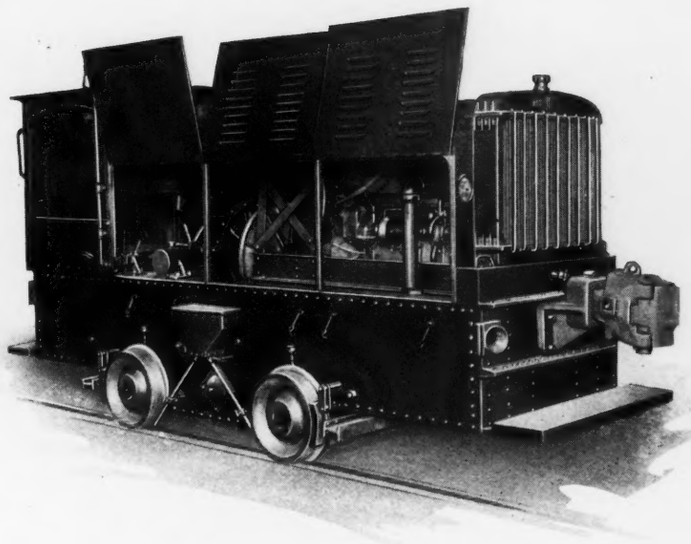
The grinding of the crankshaft pins is done on four Norton machines—two for roughing and two for finishing. A 6636-O Alundum wheel is used for both operations. In the roughing .090" of stock is removed, leaving about .010" to .015" stock to finish. The finish grinding is done to a limit of plus or minus .001" and the production is 60 a day (eight hours), for each operation.



These Bushings are Ground Directly to Size from the Rough.

Push Rod Heads

A Norton grinding machine, equipped with an Alundum 24 combination wheel, 20" x 2" x 12½", is the efficient medium for grinding push rod heads. The push rods are held in a collet which has a stop inside, the push rod projecting 2" from the base of the collet. The wheel speed is 1150 r.p.m., that of the fixture is 200 r.p.m. Production is from 850 to 900 a day, the finish is very high, and the surface must be exactly at right angles to



Industrial Locomotive, Cummings Machine Co., Buda Engine.

the axis of the push rod. The push rods are electric furnace steel, bone hardened 1/16″ deep, and a sclerescopic reading is taken after grinding. The minimum reading is 70 and the preferred reading 80.

Push Rod Shanks

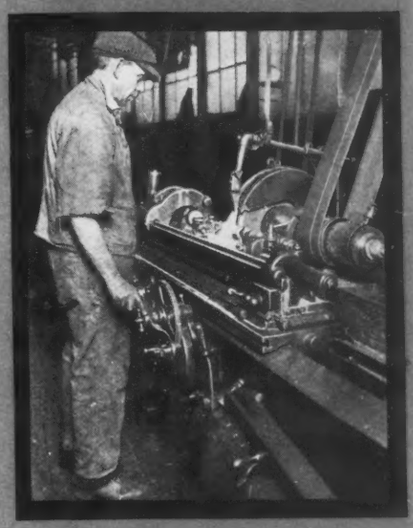
Grinding push rod shanks is a job of which the Buda Company is justly proud. Two Norton grinding machines have handled the work, one doing the roughing and the other the finishing. A ⅜″—24 tapped hole runs into the end of the push rod for a distance of ⅞″ and there is a center hole at the other end.

After the rods are rough-ground, the operator places them on a chute where they slide to the second operator who takes the finishing cut. On the roughing operation .030″ of stock is removed, leaving .005″ for the finisher. The limits are plus or minus .0005″ and the production is 900 in an eight-hour day, roughed and finished. The wheels used on both machines are Norton 24 combination M, 20″ x 4″ x 12½″.

Grinding Camshafts

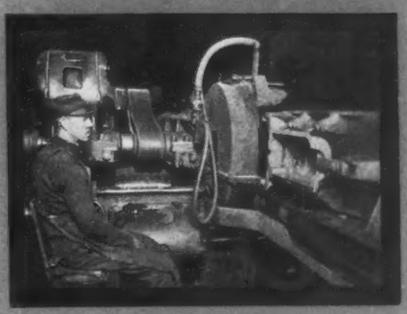
The grinding of the camshafts at this plant calls for rather large equipment. Six Norton grinding machines are employed, three for roughing and three for finishing and seven different types of cams are ground. For roughing, an Alun-





Roughing Camshafts Norton Machine Norton Alundum Wheel, 24-Q 18″x 1¾″x5″

Finish Grinding Camshafts, Norton Machine, Norton Alundum Wheel, 24 Combination L, 18″x 1¾″x5″



Grinding Oil Pans. Diamond Face Grinder. Norton 14-L Alundum Silicate Wheel.



Oil Pans, Joints are Ground, $\frac{3}{16}$" to $\frac{7}{32}$" stock removed.





Bell Housings, Water Jacket Covers and Exhaust Pipes are Ground to Make them Water and Oil Tight. Diamond Face Grinder, Norton 14-L Alundum Silicate Wheel.

dum wheel, grain 24, grade M, 18" x 1¾" x 5", is used and for finishing an Alundum 24 combination K, 18" x 1¾" x 5", wheel is used. On the roughing machine 43 camshafts are ground to a wheel. The total roughing production is 35 for an eight-hour day. There are eight cams, one eccentric on every shaft, and some cams have 5/16" of stock to be removed. From .020" to .025" of stock is left for finishing. On the finishing operation, the cams are held to plus or minus .001" and the production is 45 shafts a day.

There is grinding on practically every part of the Buda gasoline engine and in every case the finishing is accomplished through this modern means of machining which insures niceties of fit, truth in the running of the parts, a perfect turning unit.

A gasoline engine for practical, economical, and convenient use is unthinkable without grinding. Steady development of this practical method through constant research has created a science which has exactness for its limit, and which affords an ever-increasing store of grinding information. The machining problem which has received no solution, or only an unsatisfactory setting, not worth-while to the manufacturer, is welcomed by the Norton Engineering staff at Worcester as a means for experimentation which serves as a step in the evolution of the science of the grinding wheel.

NORTON COMPANY

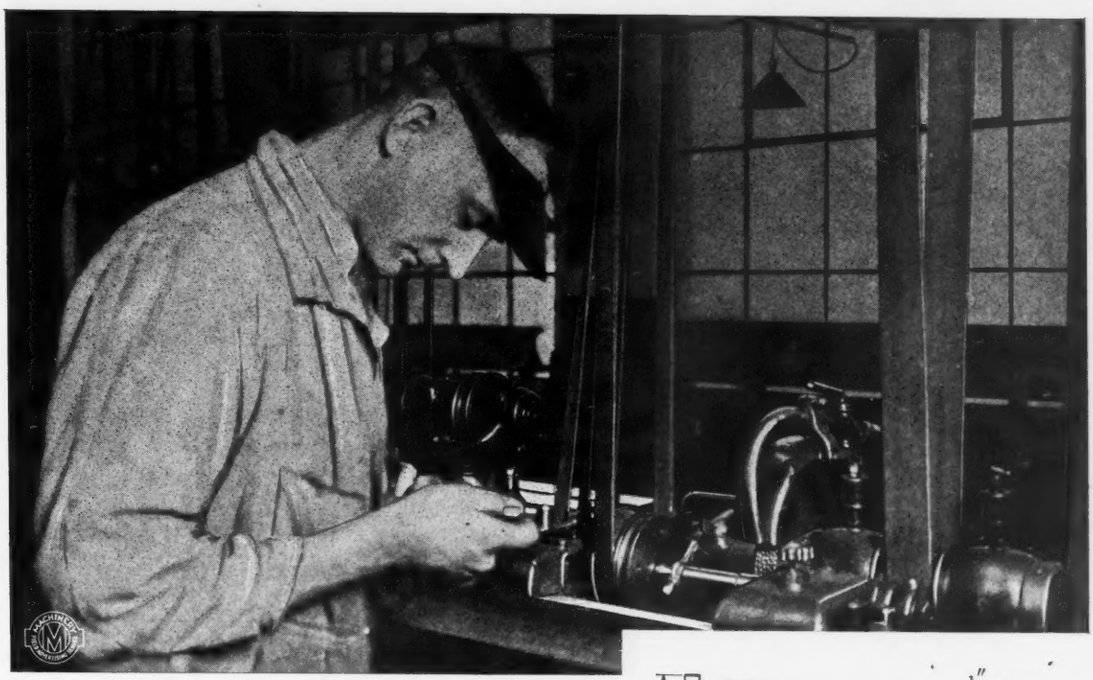
WORCESTER MASS., U. S. A.

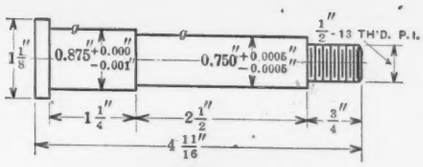
Greenfield

TRADE MARK REG. U.S. PATENT OFFICE

GM

No. 1 GRINDER





Three Years In This Shop. Accurate? Listen to This—

This Greenfield No. 1 Grinder handles *all* small cylindrical grinding for the Hartford (Conn.) Special Machinery Company, the operation illustrated being typical of the close dimensions to which much of the work is held.

It consists of grinding two diameters on studs for glass making machinery, dimensions and limits being clearly indicated in the accompanying sketch.

The machine is as accurate today as when first installed and the company is well pleased with its service—accuracy, output and cost.

There are distinctive advantages about this simple, well balanced machine which practically eliminate the weaknesses common to many similar machines.

Let us describe them.



THE GREENFIELD MACHINE COMPANY

Greenfield Mass., U. S. A.



DIVINE POLISHING SERVICE



We'll Tell You How to Get the Most from your Equipment and We'll Install an Equipment That you can Get the Most From.

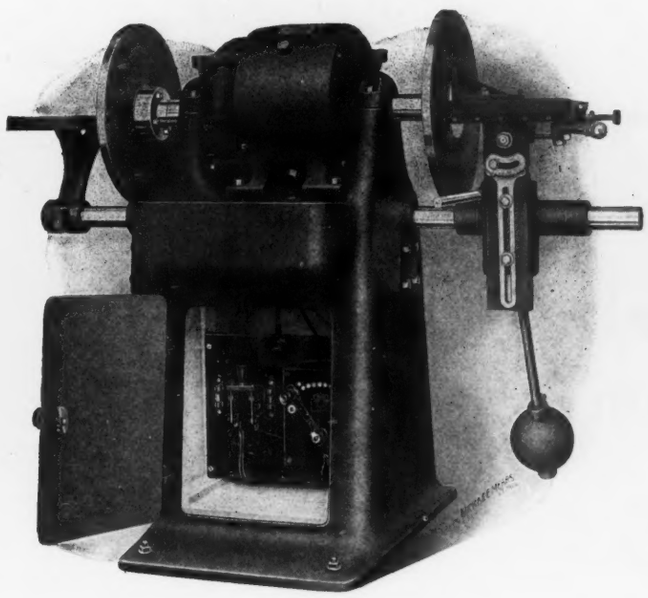
FIRST of all the *right* equipment. Next the best way to apply it. Divine Brothers' Service covers both these necessities. For example, one of our experts made a thorough investigation of the polishing requirements of the Iron City Tool Co., Shuster, Pa. He traced the progress of the work through the factory from start to finish, superintended the installation of polishing wheels, glue heater, abrasives, etc. As a result the mattocks, picks, sledges and other tools made by this concern have an attractive and serviceable finish, are more readily marketable, and the polishing costs have been reduced to a minimum.

Let us tell you what Divine Brothers' Polishing Service will do for you. Write.

ENGINEERING DEPARTMENT

DIVINE BROTHERS CO.
UTICA NEW YORK, U. S. A.

Illustrating ring wheel grinding operation.



Complete description on request.

Antigo Disc Grinders

18-inch Machine With Motor Drive

A strong, rigid, double-duty grinder at which two men can work at the same time. The machine is simple in design, durably constructed, and has many practical advantages. Its field is general grinding and the production of duplicate parts; it is rapid, accurate, economical, and not afraid of hard work.

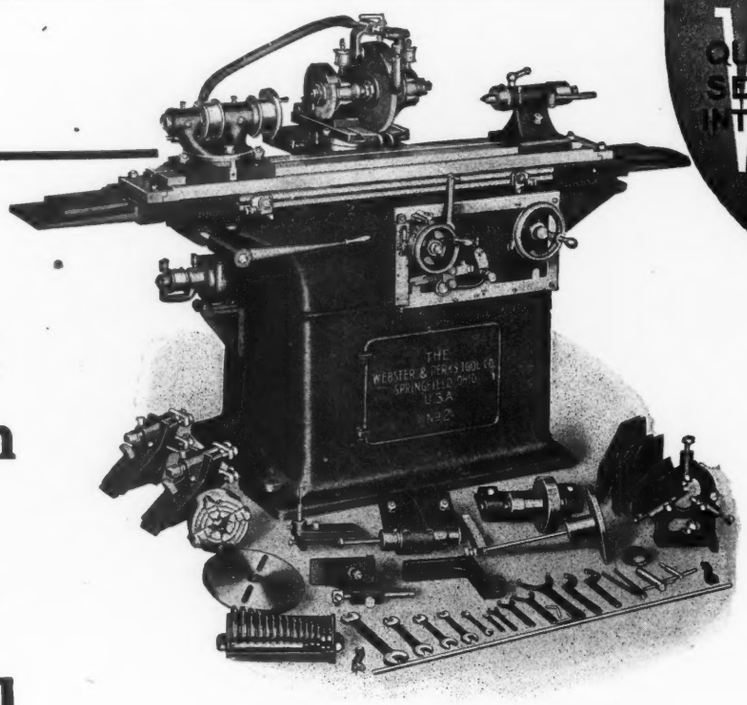
Both wheels operate simultaneously at full speed; ring wheel chucks are interchangeable with disc wheels. Tables may be plain or lever feed, both alike or "assorted." Lever feed table, adjustable to any angle up to 45 degrees, oscillates forward and backward, and has vertical adjustment of 4½". A 5 horse-power motor does the driving.

Antigo Disc Grinders are made in several styles and sizes, furnished with steel discs 30", 27", 23", or 20" diameter and adjustable ring wheel chucks 8" to 20" diameter. Don't buy machines of this type without investigating Antigo Grinders.

MURRAY-MYLREA MACHINE CO.

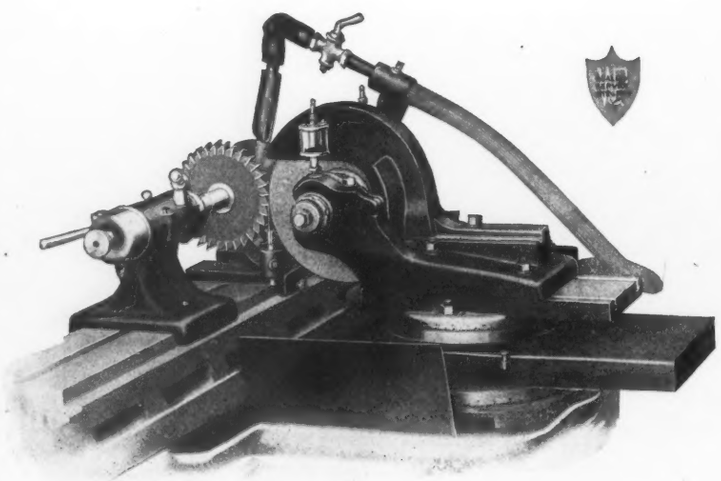
ANTIGO **WISCONSIN, U. S. A.**

Agent for Michigan: J. C. AUSTERBERRY, 65 Shelby Street, Detroit



Cylindrical Grinding on The W & P Universal Grinder

The Cutter Tooth-rest is regularly supplied with this machine



Grinding Face of Milling Cutter, with Center Wheel.

In sharpening straddle milling cutters and similar cylindrical work on which duplicate faces must be successively presented to the wheel, the cutter tooth-rest is used to locate the edges to be ground.

This attachment has such a wide and practical application to modern cylindrical and cutter grinding that we consider it indispensable, and include it regularly in the standard equipment of all our universal machines. The "blade" of the rest is made of spring steel and permits the edges to slip by.

In the set-up here shown, the work is mounted on an arbor held between centers and the center wheel used for grinding. Next month we'll show you this versatile and productive machine set up for side cutter grinding.

THE WEBSTER & PERKS TOOL COMPANY

SPRINGFIELD P. O. Box 1301 OHIO, U. S. A.

BLANCHARD

High Power Vertical Surface Grinders

This No. 10 Blanchard Grinds Dies Fast, Yet Safely

Dies are expensive and easily spoiled. The saying, "Better be sure than sorry," applies with special force to die grinding. You must be sure you do not overheat the surface or edges. With most grinders this means you must go very slowly. Not so with the Blanchard. The Blanchard will grind dies in a fraction of the time required by other machines with perfect safety.

For example, this No. 10 Blanchard ground 1/32″ from the face of each of these four 6″ by 6″ hardened dies in five minutes—less than half an hour for the lot.

Blanchard Grinders are handling this class of work daily in dozens of shops.

Many firms that use our large No. 16 grinder for production, find our No. 10 machine a great time saver in their toolrooms.

Descriptive circular on request.

Next month we will show you in this space an example of production work on the No. 10

BLANCHARD

Trade Mark Reg. U. S. Patent Office.

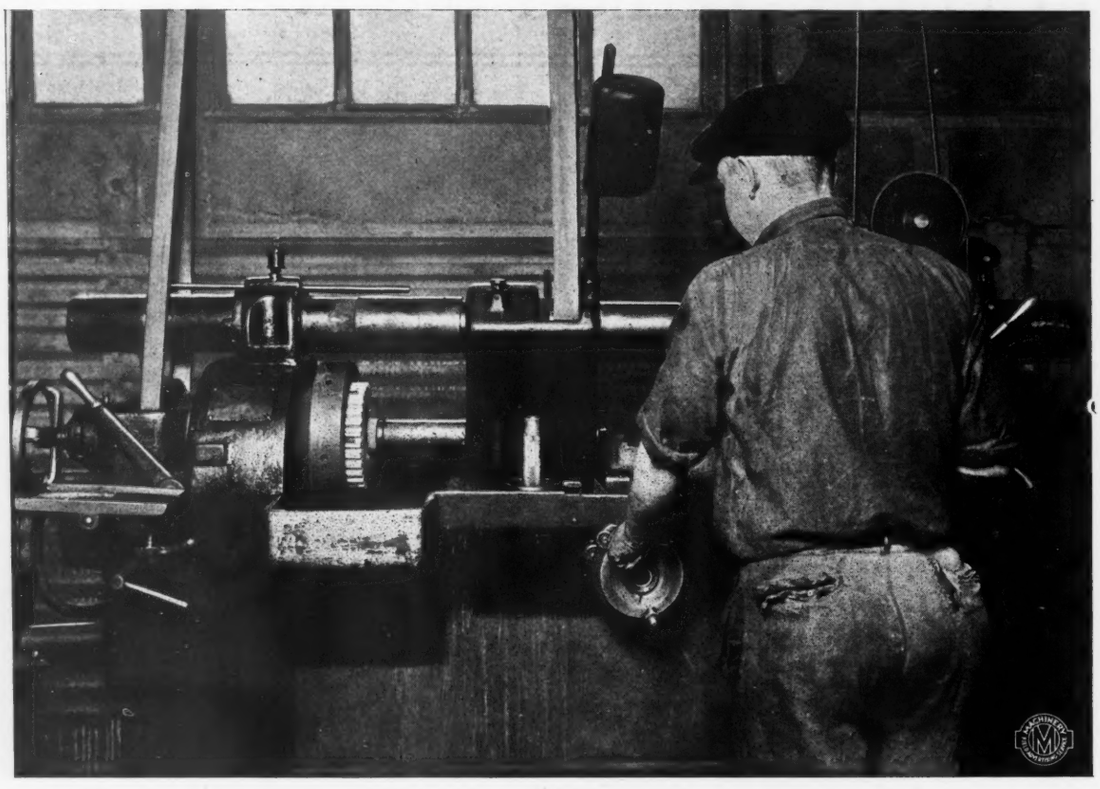


THE BLANCHARD MACHINE CO.

64 STATE STREET **CAMBRIDGE, MASS., U. S. A.**

UNITED STATES: Henry Prentiss & Co., Inc., Motch & Merryweather Machinery Co., Marshall & Huschart Machinery Co., W. E. Shipley Machinery Co., Kemp Machinery Co., Robinson, Cary & Sands Co., Pacific Tool & Supply Co. CANADA: Williams & Wilson, Ltd., F. F. Barber Mchy. Co., Ltd. GREAT BRITAIN: Burton, Griffiths & Co., Ltd. FRANCE: Aux Forges de Vulcain. ITALY, SWITZERLAND, BELGIUM, SPAIN and PORTUGAL: Allied Machinery Co. of America. SWEDEN: A/B Rylander & Asplund.

BRYANT CHUCKING GRINDERS

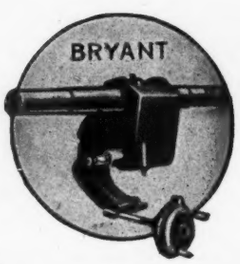


Insure Accurate Bores in Accurate Gears

Bore Grinding is in most cases an important operation in which accuracy is carefully gaged and for which the machine is carefully chosen.

The Hart-Parr Co., Charles City, Iowa, use two Bryant Chucking Grinders for this class of work. The one shown is Bore Grinding intermediate gears for Hart-Parr Tractors. The bore is two inches deep, ground to 4.375″ in diameter with limits of plus 0.003″ and minus nothing; about 0.015″ of metal is removed. Production is 15 per hour.

Bryant Chucking Grinders give good production with a high degree of accuracy on all classes of internal work that can be chucked. If you want to save time *and money* on work of this class, ask us about these machines.



BRYANT CHUCKING GRINDER CO.

SPRINGFIELD **VERMONT, U. S. A.**

DIRECT REPRESENTATIVES: Chicago, L. C. Gilchrist, 1262 Columbia Ave.; Detroit, B. J. Riordan, 263 St. Paul Ave. AGENTS: Cleveland, Cincinnati and Pittsburgh, Motch & Merryweather Machinery Co.; New York, Boston, Buffalo, Rochester, Syracuse, Scranton and Hartford, Henry Prentiss & Co.; San Francisco and Los Angeles, Berger & Carter Co.

It Cuts

That's the Secret of the Efficiency of Aloxite Cloth

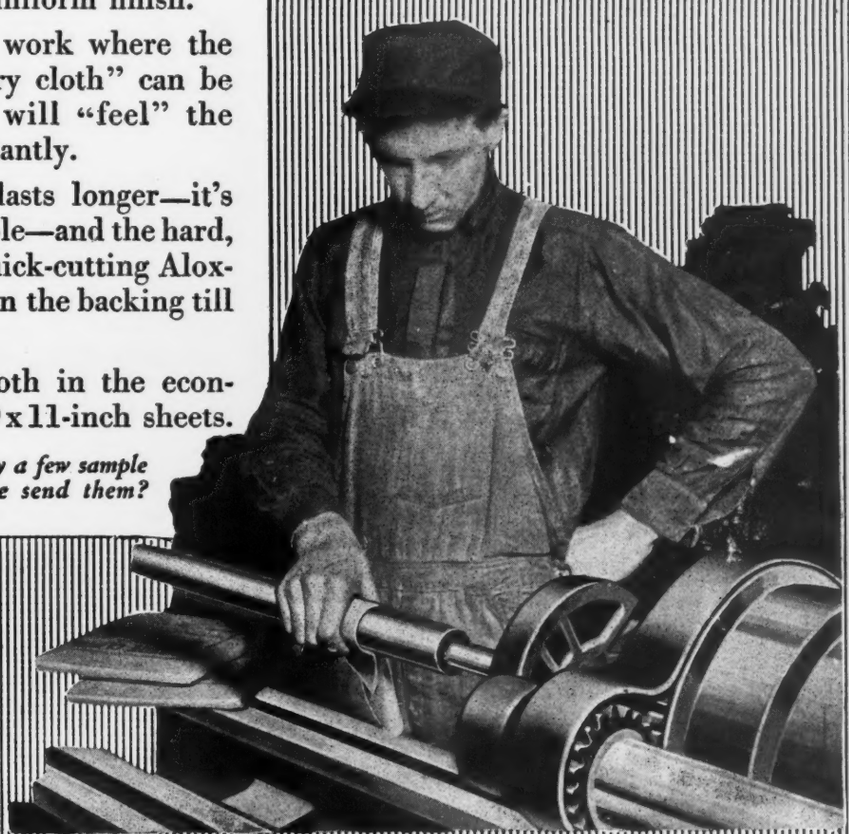
IT isn't a case of slow, time-killing rubbing when you are using Aloxite Cloth, because it cuts clean and fast, always leaving a smooth, uniform finish.

Use it on any work where the ordinary "emery cloth" can be used and you will "feel" the difference—instantly.

Aloxite Cloth lasts longer—it's extremely flexible—and the hard, sharp, tough, quick-cutting Aloxite grains stay on the backing till worn off.

Get Aloxite Cloth in the economy rolls—or 9x11-inch sheets.

Will you try a few sample sheets if we send them?



Aloxite Cloth

The Cloth that cuts

The Carborundum Company, Niagara Falls, New York

New York Chicago Boston Philadelphia Cleveland Cincinnati
Detroit Pittsburgh Grand Rapids Milwaukee

Lafayette Universal Grinder

Read What This User Says—

LAFAYETTE

THE BORG & BECK CO.
MANUFACTURERS OF
The Borg & Beck Clutch
For Automobiles & Commercial Vehicles
CHICAGO, ILL.

C. W. BORG, President
MARSHALL BECK, Treasurer
GEO. W. BORG, Secretary
ENGINEERING & SALES OFFICE
914 SO. MICHIGAN AVE.
FACTORIES
CHICAGO & MOLINE, ILL.

ADDRESS REPLY TO
6515 So. MENARD AVE.

SUBJECT

June 11th, 1920.

Mr. W. M. Manion, President,
Lafayette Tool & Equipment Co.,
21 S. 12th Street,
Philadelphia, Pa.

Dear Sir:

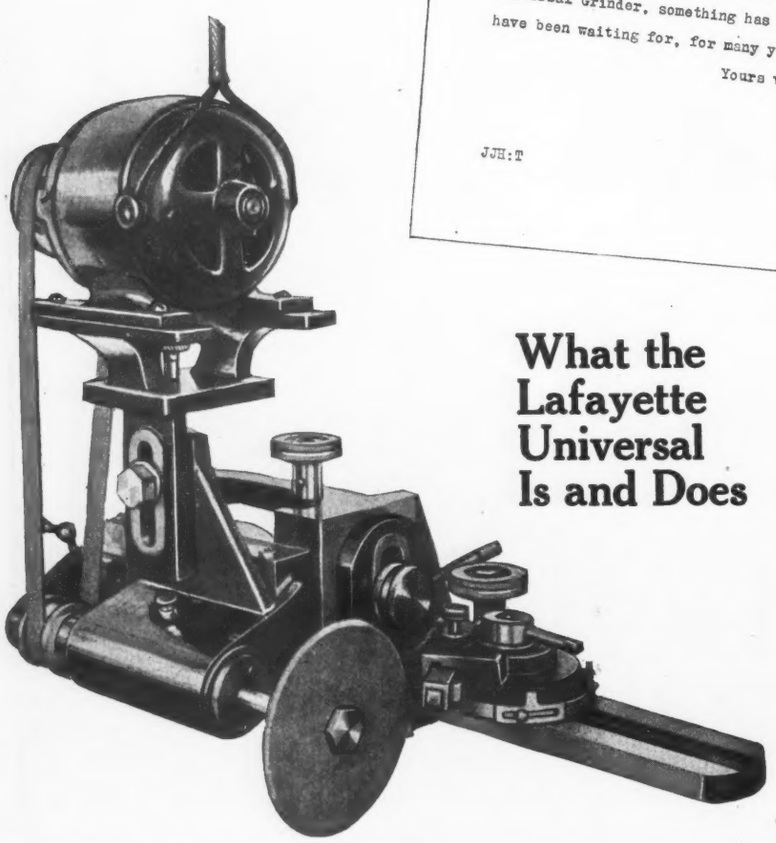
We have now been using one of your Universal Grinders for about three weeks in our Tool Department and elsewhere throughout our plant, and we thought it may be of interest to you to learn just what the opinion of our department heads is, regarding the performance of the machine.

The report seems to be general that it is a very high class product, equal to grinding threads, producing an excellent finish in grinding holes, outside diameters and threads of all pitches.

It is most highly appreciated by our gauge and toolmakers. In fact, the general impression is, that in the Lafayette Universal Grinder, something has been offered to the trade that they have been waiting for, for many years.

Yours very truly,
THE BORG & BECK CO.
J. J. Hartley
Factory Manager.

JJH:T



What the Lafayette Universal Is and Does

A precision tool of strong and rigid construction to grind threaded and plain cylindrical, internal, surface, cutter and tool work in wide variety. Has extraordinary accuracy—limits of .0001" are easy to attain.

Use the Lafayette for grinding threads, taps, dies, hobs, worms, reamers, gages of all description, drill bushings, circular forming tools, mandrels, end mills, counterbores and a hundred other types of work. Where can you find a grinder for $240.00 which will perform so many widely varying operations—which will so quickly repay your investment?

Write for Catalog

THE LAFAYETTE TOOL & EQUIPMENT CO.

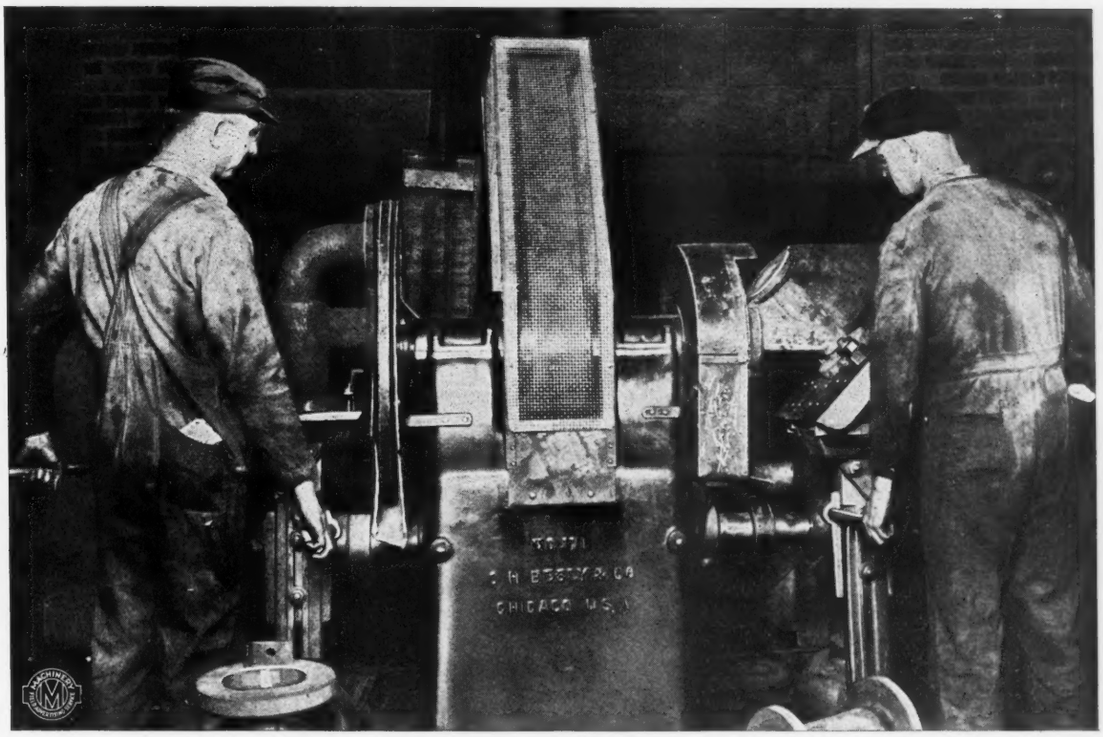
MANUFACTURERS OF PRECISION TOOLS

General Sales Offices:
21 South 12th St., Philadelphia, Pa.

Works:
Lafayette, Indiana

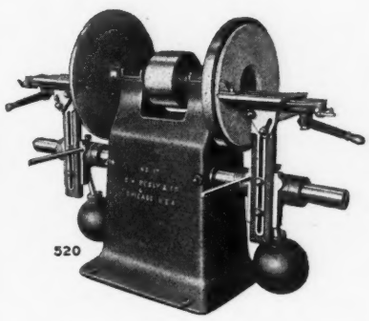
BESLY GRINDING

vs. Facing in the Lathe



Simple and Economical

BESLY CHICAGO



A little more than a year ago, at the Northwest Engineering Works, of the Emergency Fleet Corporation, Green Bay, Wisconsin, various cast-iron flanges for tug boat fittings were faced on a lathe. Today they are handled by this No. 17 Besly Grinder in half the time and with only unskilled operators.

This machine is equipped with a ring wheel chuck on one side and a disc wheel opposite.

When photographed, it was facing a manifold on one end and a "Y" on the other—the latter being located by a readily adjustable angle plate. Stock removed never exceeds 1/16". With speed, economy and versatility all to the credit of Besly Grinding—both on odd jobs and long runs—you'll find profit in a closer investigation.

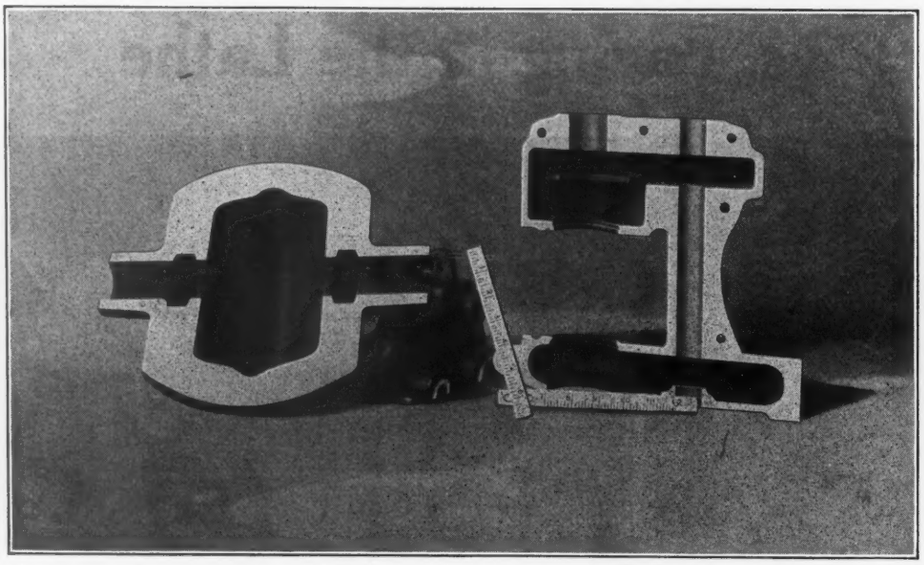
Catalog on request.

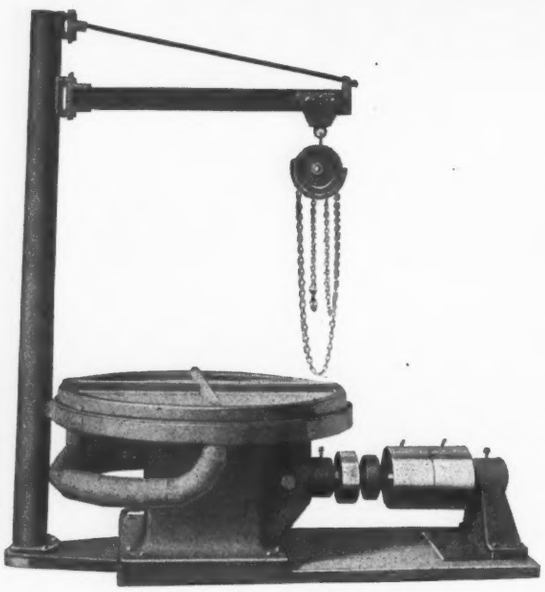
CHARLES H. BESLY & COMPANY

Originators of Disc Grinders

120-B North Clinton Street **CHICAGO, ILLINOIS, U. S. A.**

We Know You Can Do It!





It's easy to obtain good production on gear housings similar to those shown above, when you finish them on the GARDNER No. 24 Disc GRINDER equipped with our G. I. A. Discs.

50 Per Hour On This Job—
We Know You Can Do It, Too!

"When You Think of a Disc Grinder, Think of a Gardner"

GARDNER MACHINE COMPANY

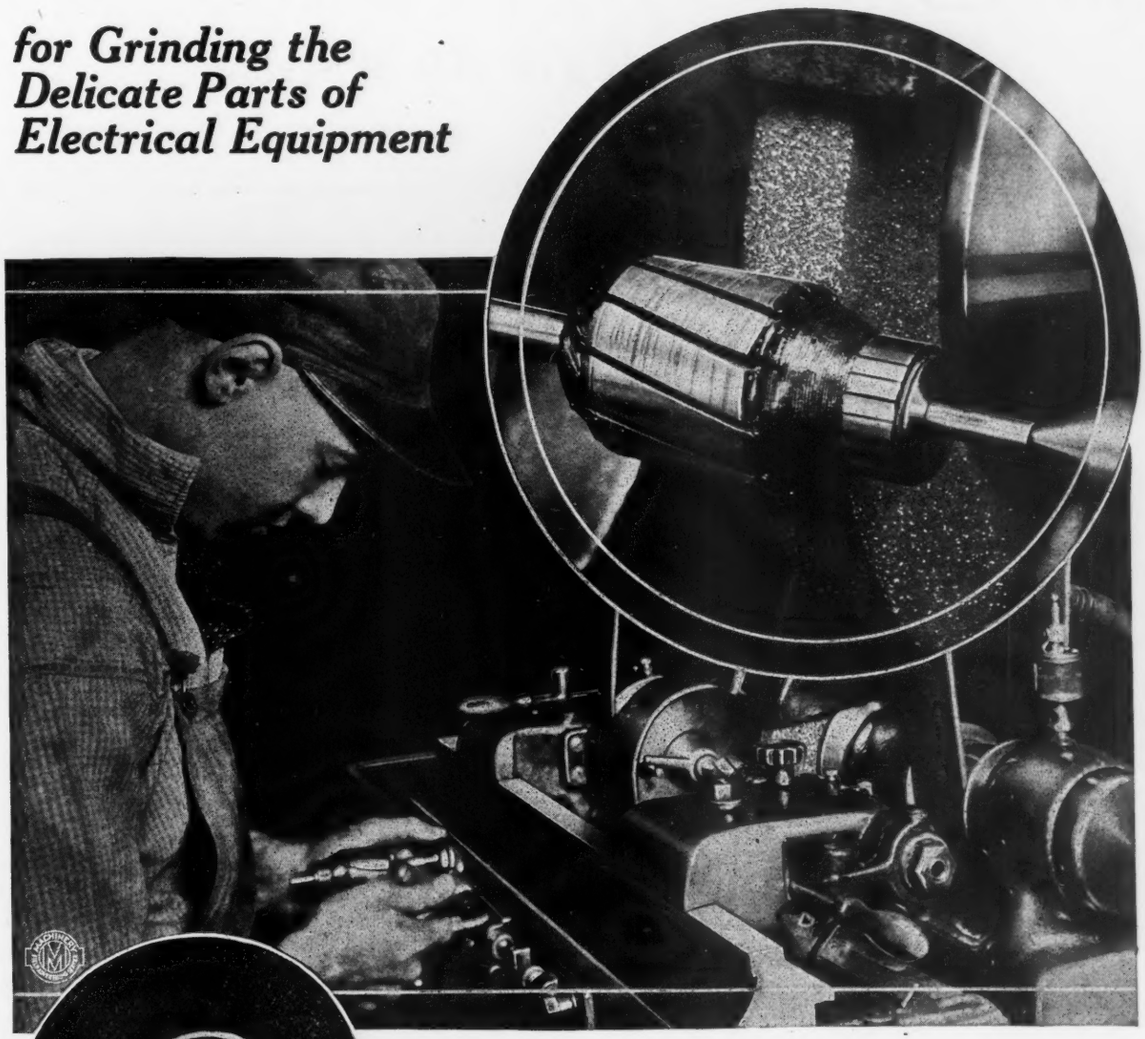
414 Gardner St., Beloit, Wis., U. S. A.

New York Office: 6 Church Street — Chicago Office: 32 N. Clinton Street

REPRESENTATIVE IN GREAT BRITAIN: Alfred Herbert Co., Ltd., Coventry, England
REPRESENTATIVE IN PARIS, TURIN, AND BARCELONA: Allied Machinery Co. of America

Abrasive Grinding Wheels

for Grinding the Delicate Parts of Electrical Equipment





There are few things in the realm of mechanical equipment which must be ground with such extreme care as parts for electric motors and apparatus.

This photograph was taken in a large New York City plant where Abrasive Grinding Wheels are used exclusively for this type of work.

The operation being performed is the grinding of an armature for an electric motor. Rough grinding removes .008″ and finish grinding .004″.

There's an Abrasive Grinding Wheel for every grinding need; let us tell you which is best for each job in your plant. Write.

TRADE ABRASIVE MARK

ABRASIVE COMPANY MAIN OFFICE AND WORKS **Bridesburg, Philadelphia**

CHICAGO BRANCH: 566 West Washington Boulevard

FOREIGN AGENTS: England, Wales, Scotland, Ireland, Burton, Griffiths & Co., Ltd., London; France, Belgium, Switzerland, Fenwick Freres & Co., Paris, Liege and Zurich; Norway, Sweden, Denmark, Akt. Wilh. Sonesson & Co., Malmo, Stockholm, Gothenburg, Copenhagen; Finland, Julius Tallberg, Helsingfors; Holland. Spliethoff, Beeuwkes & Co., Rotterdam; Spain, J. Vilaseca Bas, Barcelona; Australia, Engineering Supply Co. of Australia, Ltd., Brisbane; B. K. Morton, Prop., Ltd., Melbourne and Sydney; Argentine Republic and Uruguay, A. G. Burbanks, Buenos Aires; Peru, Enrique Humphreys & Co., Lima; Manila, P. I., Milton E. Springer & Company. CANADIAN AGENTS: Montreal, Toronto, Canadian B. K. Morton Co., Ltd.; Halifax, Austen Bros.

DESMOND-STEPHAN
GRINDING WHEEL DRESSERS

Efficient Tools For All Wheels

Desmond-Huntington Dresser



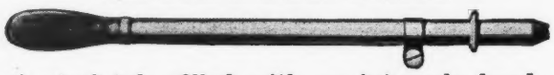
Made in three sizes. For use on the largest and hardest wheels, where quick action is desired. The cutters of No. 2 are 2⅜″ in diameter and have a width of face of 1″.

Diamond Hand Tool



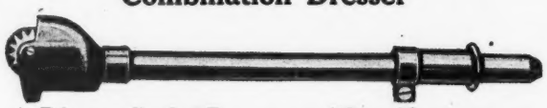
We import the highest quality diamonds and will gladly send stones for inspection.

The Diamo-Carbo Dresser



A steel tube filled with an intensely hard abrasive which will cut all but the coarsest and hardest wheels.

Combination Dresser



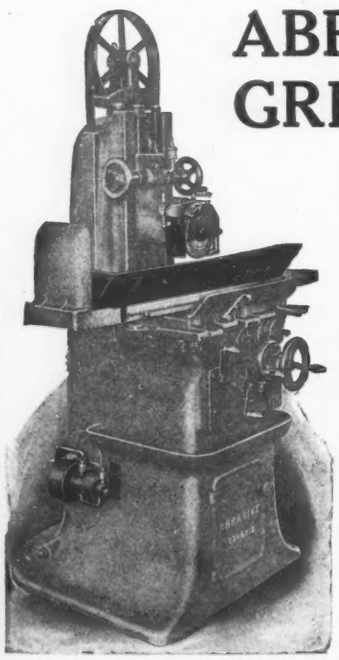
A Diamo-Carbo Dresser with a Sherman or Huntington Dresser set in the handle end; useful for dressing all classes of wheels up to the coarsest and hardest.

Write for a complete list (with prices) of our entire line.

THE DESMOND-STEPHAN MFG. COMPANY

URBANA — The Canadian Desmond-Stephan Mfg. Co., Ltd., Hamilton, Ont. Alfred Herbert Ltd., Agents for Great Britain. — OHIO, U.S.A.

ABRASIVE GRINDERS



The cut shows one of these machines equipped with centrifugal pump. Spray guards and special wheel hood for wet grinding.

CAPACITY
22 × 8 × 12
Wheels to 8-inch diameter by ¾-inch thick.

Circular?

ABRASIVE MACHINE TOOL CO.

F. N. MacLEOD, President and General Manager
EAST PROVIDENCE RHODE ISLAND

FOREIGN AGENCIES: Aux Forges de Vulcain, France; Burton, Griffiths & Co., Great Britain; I. Lambercier & Co., Switzerland; Selson Engineering Co., Italy; Wilh. Sonesson & Co., Sweden; A. R. Williams Mchy. Co., Canada.

What Do DETROIT-STAR GRINDING WHEEL CO. You Grind?

Grinding already occupies an important place in modern shop practice and there's no limit apparently to its application.

Detroit-Star Grinding Wheels are available in grains, grades, shapes and sizes to handle any operation to which grinding may be applied.

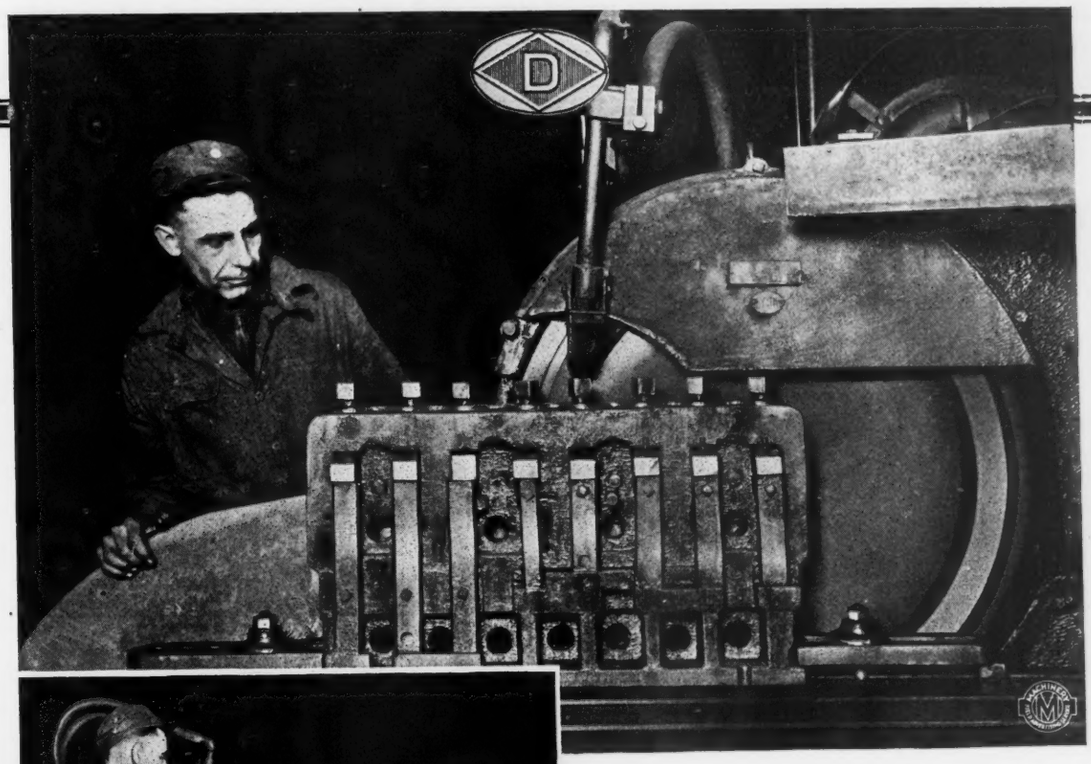
Catalog on Request



DETROIT-STAR GRINDING WHEEL CO.

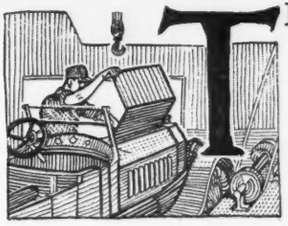
Detroit Michigan U. S. A.

New York Office: 9-11 W. Broadway, New York City, C. H. Westerberg, Mgr.

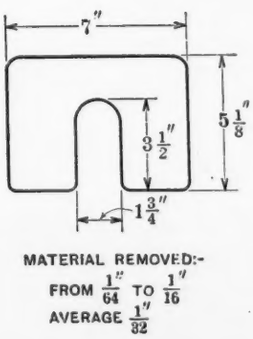




How's This, Mr. Production Manager?



THE American Hoist & Derrick Company, St. Paul, Minn., used to finish friction head gib castings for American Hoisting Engines on a milling machine—one every 7 minutes. Nowadays, however, these parts are located in a simple fixture on this Diamond Face Grinder and finished four at a time in 12 minutes—3 minutes each—an increase of more than 100 per cent in output. The accompanying sketch shows the requirements for the operation.



Saving of skilled labor and maintenance is also frequently an appreciable item in favor of "Diamond Grinding."

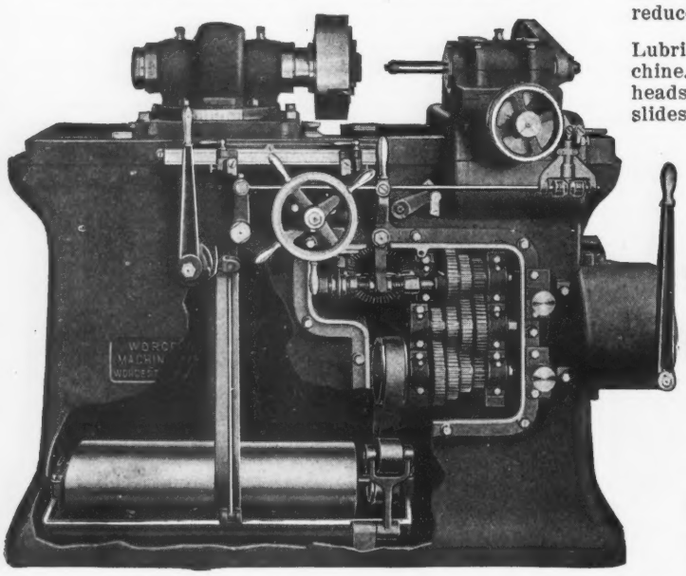
Other examples of Diamond Grinding are described in our pamphlet "The Diamond on the Job." It is yours on request.

Diamond Machine Co.
Providence, R.I., U.S.A.

EXCLUSIVE AGENTS: Chas. A. Strelinger Co., Detroit, Mich.; E. A. Kinsey Co., Cincinnati, O.; E. L. Easley Machinery Co., Chicago, and Moline, Ill., and Milwaukee, Wis.; Strong, Carlisle & Hammond, Cleveland, O.; Somers, Fitler & Todd Co., Pittsburgh, Pa.; Vonnegut Mchy. Co., Indianapolis, Ind.; Williams & Wilson, Ltd., Montreal, Que., Can.; Chas. Churchill & Co., Ltd., London, Eng.; Fenwick Freres & Co., Paris, France; The Horne Co., Ltd., Tokyo, Japan.

A Wide Range Grinder—More Than Ordinarily Rigid

The
CHURCHILL
Internal Grinder



The Churchill Internal Grinder with gear box cover removed to show feed and speed mechanism.

With all internal mechanism of this machine thus fully exposed, its distinctive advantages will be readily understood—the location of the work-head drum on ball bearings, six inches from the bottom of the base, the automatic box in which practically the whole control centers, and the system of firmly gibbed slides by which both wheel head and work spindle are rigidly secured, and vibration is reduced to the minimum.

Lubrication is another well-planned feature of this machine. Oil pockets in the base, oil cups on work and wheel heads, and oil pockets in the ways on which the work table slides provide an ample supply to all moving parts.

This machine grinds 10" deep and swings work up to 18" diameter.

Details on request.

Churchill-Morgan Crittsinger, Inc.

Formerly

Worcester Machine Works, Inc.

Sawyer Bldg. WORCESTER, MASS.

Convenient, Rigid and Compact

WOODS
No. 1 Universal Tool and Cutter Grinder

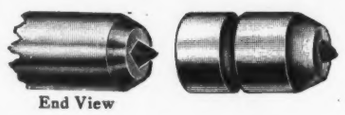


Made in Three Sizes

Box type knee entirely encircling the column, table well gibbed for its entire length and swiveling type headstock all make for rigidity with minimum floor space; graduation for taper grinding, adjustable stops and micrometer dials for both elevating and cross travel screws aid the operator in making adjustments, and a full complement of attachments for all classes of internal and surface grinding within the range of "its 9" swing" make this machine both popular and profitable in any tool-room.

WOODS ENGINEERING CO.

ALLIANCE OHIO, U. S. A.



End View

FRANCIS
Diamond Grinder Tools

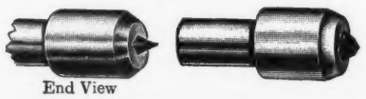
for truing emery and carborundum wheels are giving great satisfaction everywhere because of the hard and high quality diamonds used. They will keep your abrasive wheels in good cutting condition.

Ask for descriptive circular and let us send you an assortment for selection.

FRANCIS & CO.

50 State St., Hartford, Conn., U. S. A.

Established in 1799. First National Bank Bldg.

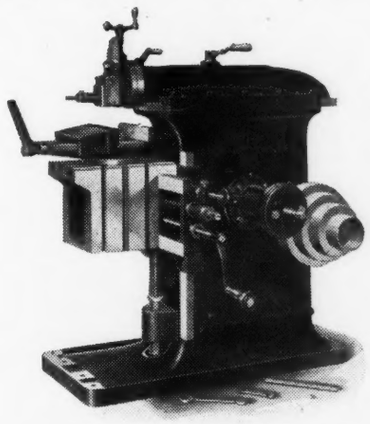


End View



WHIPP Crank Shapers

16" Single Geared—20" Back Geared



The design and construction of Whipp Shapers have made them in demand for general work. Only the best of materials are used, and unusual accuracy is maintained.

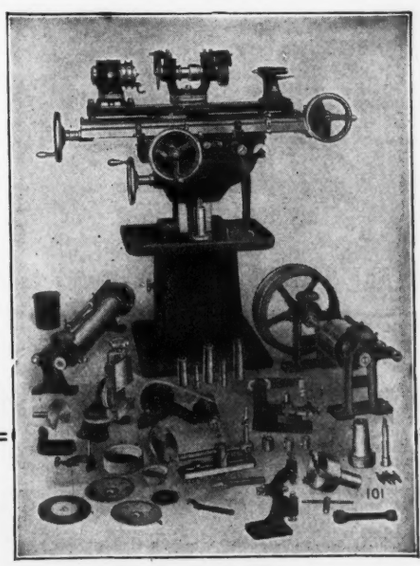
If you have work requiring a shaper—investigate what we have to offer.

Complete information gladly sent on request

The Whipp Machine Tool Co.
SIDNEY **OHIO**

OAKLEY No. 2

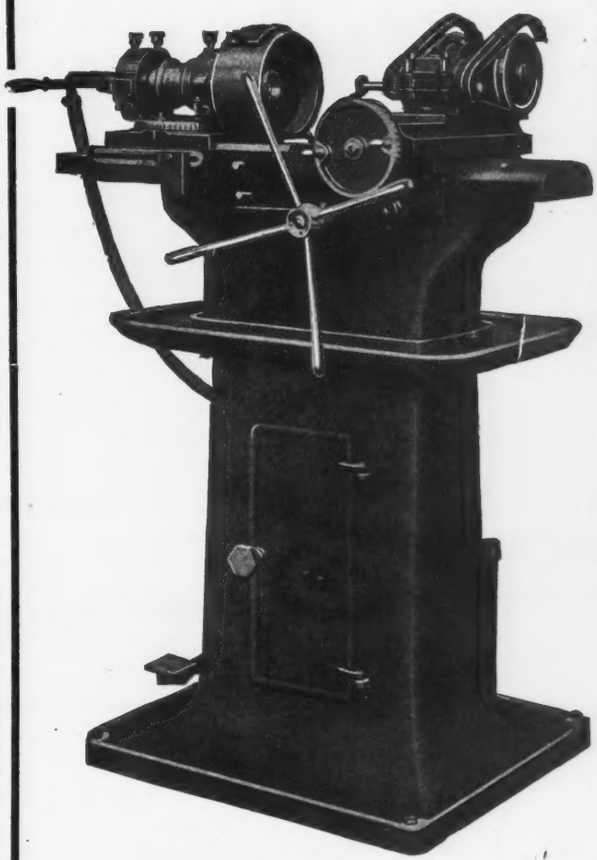
UNIVERSAL CUTTER and TOOL GRINDER



Built as a grinder should be. Exceptionally heavy—rigid and accurate. Adapted for all tool room grinding. *Send for detailed catalog.*

THE OAKLEY MACHINE TOOL CO.
OAKLEY, CINCINNATI **OHIO**

CAPITAL
Internal Grinder



Forward!

Looking forward we soon realize that there must be a radical change in equipment now if we are to successfully compete with conditions.

Grinding, which has grown greater in importance year by year ever since the advent of the machine tool, will occupy a more important place than ever.

In the front rank of modern grinding equipment comes the Capital Internal Grinder—a *machine tool* for grinding holes 3/16" to 2" in depth, accurate within limits of .0001". The facts are in Bulletin No. 2. Ask for a copy.

LANSING STAMPING AND TOOL COMPANY
LANSING **MICHIGAN**



VITRIFIED
GRINDING WHEELS

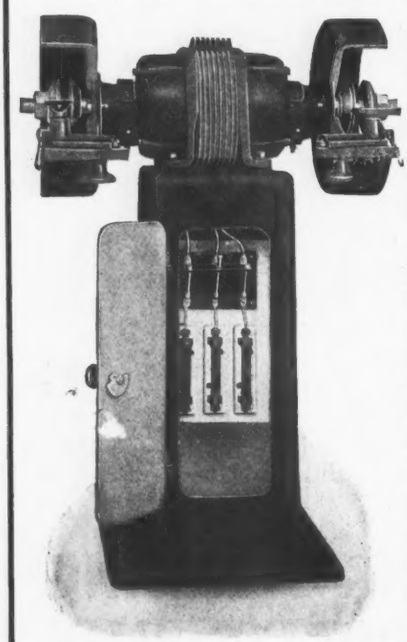
Reputation rather than appearance should be your standard for judging grinding wheels. "Beauty is only skin deep" and grinding wheels to be profitable must give uniformly satisfactory service clear down to the stub.

So take a look at the service records of Vitrified Grinding Wheels. You'll be surprised to find how much more work they produce, how much less dressing and truing they require and how much more economically "Vitrified" shops are run.

Catalog lists and describes the whole line.

VITRIFIED WHEEL CO.
Westfield, Mass.

RANSOM
Motor Driven Grinder



Fitted With General Electric Motor

Dust proof machines, compact, well built and carefully balanced, made to carry wheels from 12" to 30" in diameter.

The cut shows our No. 11 machine which carries 12" wheels.

RANSOM MANUFACTURING CO.
OSHKOSH WIS., U. S. A.



Maine to California

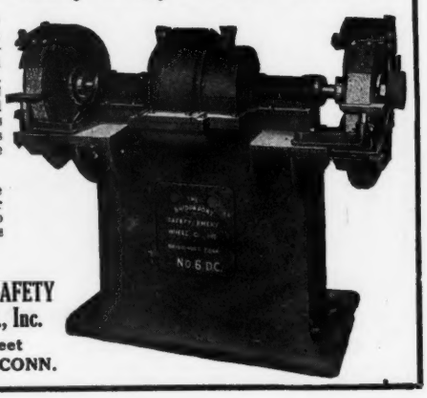
Meaning that the Waterbury Grinders are resident in every state. These machines handle die, toolroom and surface grinding. Simple, accurate, fast, efficient with 9" x 18" work space, three point suspension table support, capacity for hard work and a record for dependability, they have advantages you can't afford to overlook. Circular sent on request.

THE BLAKE & JOHNSON CO., Waterbury, Conn., U.S.A.

Bridgeport Heavy Duty Floor Grinders

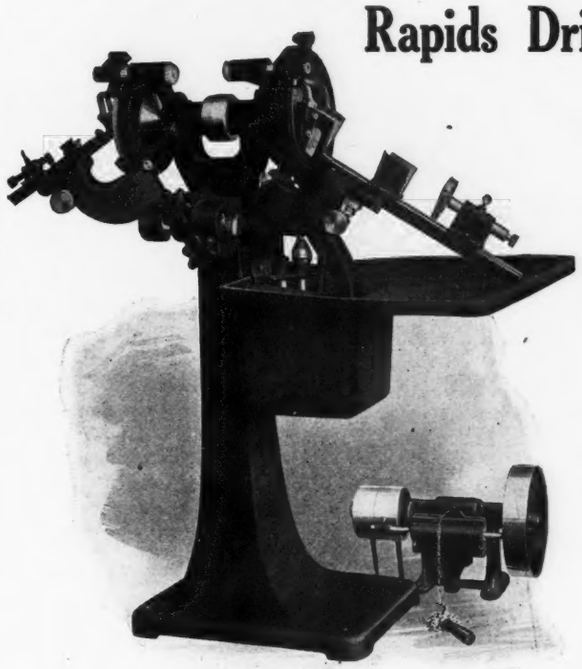
produce results and save power. Heavy Bases, Large Spindles, Powerful Motors and Ball Bearings are reasons why. Safety Collars and Steel Guards give the needed Safety. These are points the wise buyer considers today. Investigate the Bridgeport Line.

Catalog showing our line of 450 belt and motor driven grinders, also grinding wheels, is yours for the asking.



THE BRIDGEPORT SAFETY EMERY WHEEL CO., Inc.
83 Knowlton Street
BRIDGEPORT CONN.

Correct Drill Grinding Means Quick Drilling—Grand Rapids Drill Grinders Guarantee Both

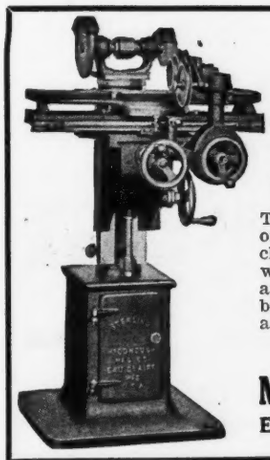


The cost of an operation is more influenced by the condition of the tools used to perform it than by any other single factor. Correctly ground drills may make all the difference between profit and loss in your drilling operations.

Drill grinding the "Grand Rapids" way will speed up your drilling work—will lengthen the working lives of your drills. Grand Rapid Drill Grinders will sharpen your drills with uniform, predetermined accuracy. We guarantee it.

Send for your copy of the Grand Rapids Drill Grinder Book.

GRAND RAPIDS GRINDING MACHINE CO.
29 Ottawa Avenue, N. W. **GRAND RAPIDS, MICH.**



STERLING

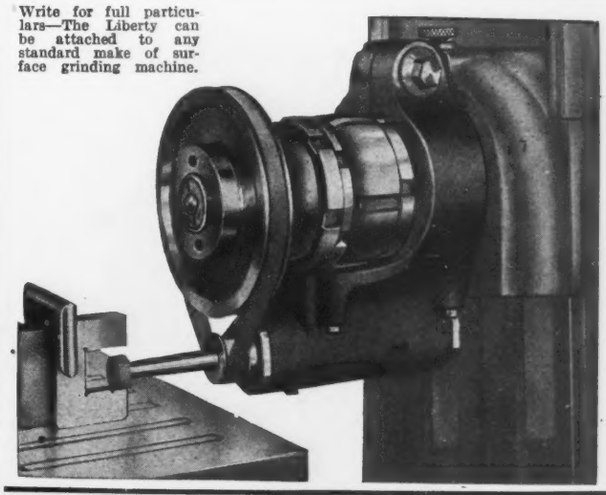
Universal Cutter and Reamer Grinder

Tool-rooms need the convenience of this grinder, adapted for all classes of small work, and provided with table which revolves entirely around head. Swings 9", takes 16' between centers; a durable, dependable, economical machine.

Write for circular

McDONOUGH MFG. CO.
EAU CLAIRE WIS.

Write for full particulars—The Liberty can be attached to any standard make of surface grinding machine.



A HIGH SPEED ATTACHMENT FOR YOUR SURFACE GRINDER

SPECIFY THE LIBERTY

Put the Liberty on your pay-roll—a high grade, high speed attachment for surface grinders.
Finish your work the modern way, by grinding, but DON'T grind a part of it and omit the grinding of an important surface solely because you can't reach it with big wheels.
WAIT just long enough for us to send you a LIBERTY and see for yourself what splendid results it will give right on your own work.
Furnished ready for work, including an assortment of wheels most suited to the average kinds of work.
High Speed spindle runs 15,000 to 20,000 R.P.M. driven by an endless canvas belt, which can be simply yet positively adjusted to the correct tension.

LIBERTY TOOL AND GAUGE WORKS
Woonsocket, R.I.

Emery Wheel Dressers
Two Sizes Nos. 1-2
CUTTERS
We make the regular Huntington (Pattern) for all sizes.
Roughing for No. 1 and 2. Paragon for No. 1 only.
GEO. H. CALDER Lancaster, Pa., U. S. A.

BRISTOL PRECISION ROTARY SURFACE GRINDER
is guaranteed to grind accurately within 0.00025". Let us send catalog of complete line of high grade tools
BRISTOL MACHINE TOOL COMPANY
BRISTOL, CONN.
Successor to C. G. CARRIGUS MACHINE COMPANY

Time and Money Savers



REID No. 2 SURFACE GRINDER

An efficient grinding unit for both toolroom and factory, it is both accurate and easily operated.

Pushrod at center of hand wheel stops and starts instantaneously. Close limits and speedy production are combined.

The Reid Universal Angle Fixture

facilitates the setting up of work on drilling, milling, planing, shaping and grinding machines. Is invaluable for die sinking, tool and experimental work. Sizes 6" x 9", 8" x 12" and 12" x 18".

Write for details.

Reid Brothers Co., Inc.
BEVERLY MASS., U. S. A.
English Agents:
Oliver Machinery Co., Ltd., 201-203 Deansgate, Manchester, England



Grinding Wheels
Abrasives
Abrasive Cloths
Dressing Tools
Grinding Machinery

We manufacture grinding wheels for all purposes.

Clevite for steel and hard metals.

Clevorundum for cast iron and soft metals.

Our "Silicate" wheels can be manufactured to your order in a few days, thus avoiding delay and inconvenience in your factory through having to wait several weeks for deliveries.

We carry a full line of ABRASIVES for the polishing trade.

THE CLEVELAND ABRASIVE WHEEL CO.
2629 East 25th Street CLEVELAND, OHIO

The Profit in Grinding is All in the Wheel



Sterling Grinding Wheels

insure a high percentage—increase output and lower the cost of high class grinding.

Write for Catalog

The Sterling Grinding Wheel Co.
FACTORIES AND OFFICES: TIFFIN, OHIO
Selling Agency:
L. BEST COMPANY, 28-30 West Broadway, New York
Chicago Store: 30 North Clinton St.

Multi-Graduated Precision Grinder

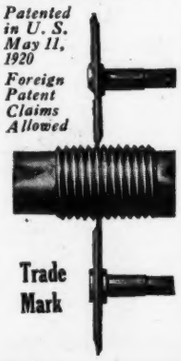
For Thread Grinding

Accurate, Rapid, Economical, price within the reach of any shop

"DUPLEX THREAD GRINDER"

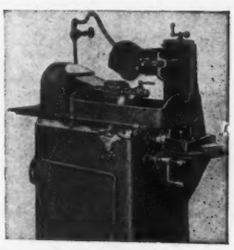
For production grinding of threads

Patented in U. S. May 11, 1920
Foreign Patent Claims Allowed



Trade Mark

PRECISION AND THREAD GRINDER MFG. COMPANY
Mfg. Plant and Offices:
1932-34 Arch Street, Philadelphia, Pa.



Hobs--Hobs--Hobs

Reduced to Just Plain

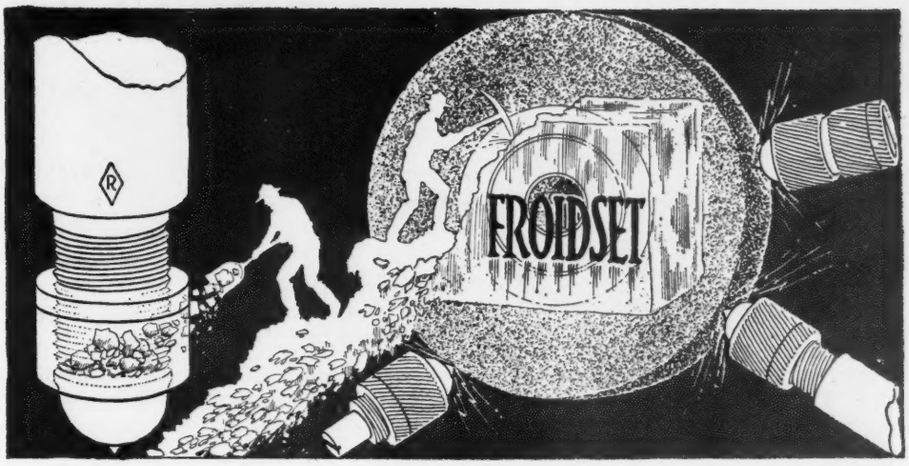
HOBS

By a common sense method of economical and rapid grinding in an accurate automatic machine. **DON'T RUIN** your expensive hobs by sharpening them with the usual makeshift methods.

Our machines in sizes to take every size Hob.

Send for circular "HY"
Automatic Hob Grinder
The H. E. Harris Engineering Company
Bridgeport, Conn.

How the Cost of Dressing Emery Wheels Can Be Reduced!



By Mounting the Diamonds Used for That Purpose, in Froidset Holders

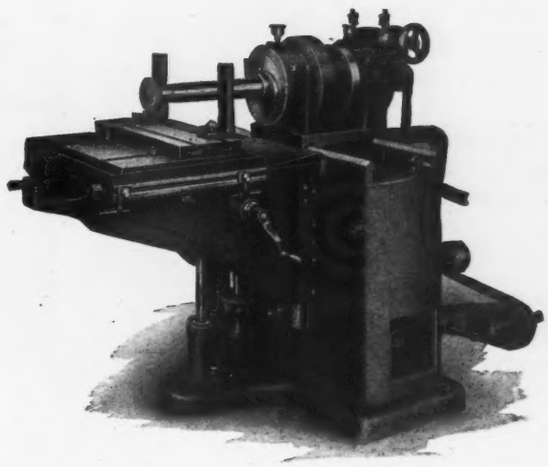
Secures better service, more durability, prevents carbonization, softening of stone, loss of weight, checks or fractures. We will set one of your own stones in Landis, Norton or hand tool dresser GRATIS for a test. For descriptive circular write Tool Department.

THE S. ROSE COMPANY, Inc., 1133 Broadway, New York City

THE LARGEST STOCK OF INDUSTRIAL DIAMONDS FOR ALL PURPOSES CONSTANTLY ON HAND

MADISON CYLINDER GRINDER

A simple, rigidly constructed cylinder grinding machine particularly adapted to a wide range of work.



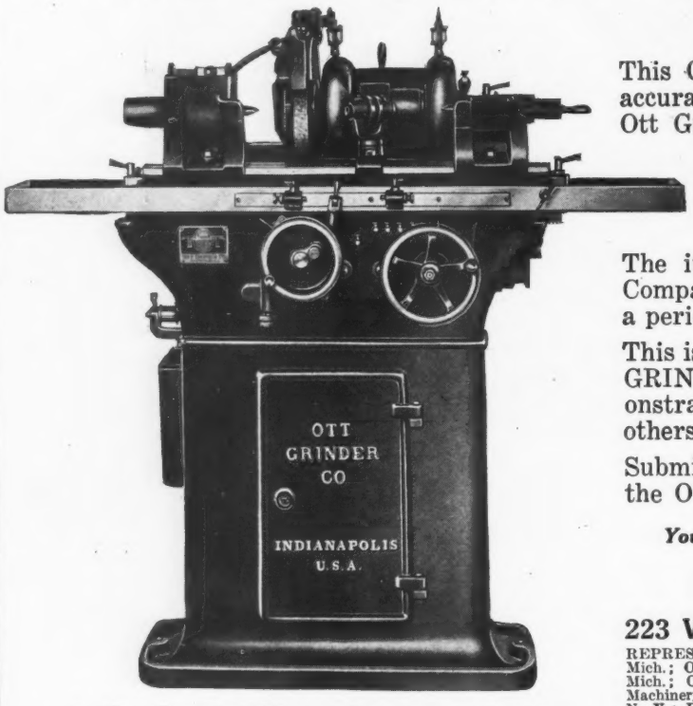
Write for particulars

MADISON MACHINE TOOL COMPANY

609 East Washington Avenue Madison, Wisconsin

Twenty Ott 5" x 18" Plain Grinding Machines

Have been installed in the grinding department of the National Twist Drill & Tool Co. of Detroit, Mich.



Ott 5 x 18 Plain Grinding Machine with Automatic Feed

This Company has found that the simplicity, accuracy, quality and production capacity of Ott Grinding Machines answer their requirements to such an extent that as additional equipment is required to meet their increased production demands, OTTS have been purchased.

The installation of the National Twist Drill Company has been covered by four orders over a period of about two years.

This is but one example of the satisfaction OTT GRINDING MACHINES have given, as demonstrated by repeat orders. There are many others.

Submit your grinding data to our dealers or to the OTT Service Department.

You will be furnished with production data of value

OTT GRINDER CO.

223 W. Tenth St. Indianapolis, Ind.

REPRESENTED BY: McMullen Machinery & Supply Co., Grand Rapids, Mich.; Ogden R. Adams, Rochester, N. Y.; Cadillac Tool Co., Detroit, Mich.; Cleveland Tool & Supply Co., Cleveland, Ohio; Coghlin-Kirkby Machinery & Supply Co., Toledo, Ohio; Syracuse Supply Co., Syracuse, N. Y.; Dale-Brewster Machinery Co., Chicago, Ill.; Swind Machinery Co., Philadelphia, Pa.; L. S. Devos, Export Representative, New York, N. Y.; The Fairbanks Co., St. Louis, Mo.; F. O. Stallman Supply Co., San Francisco and Los Angeles, Cal.; Barbour, Love & Woodward, Inc., New York, N. Y., and Selson Engineering Co., London, England.

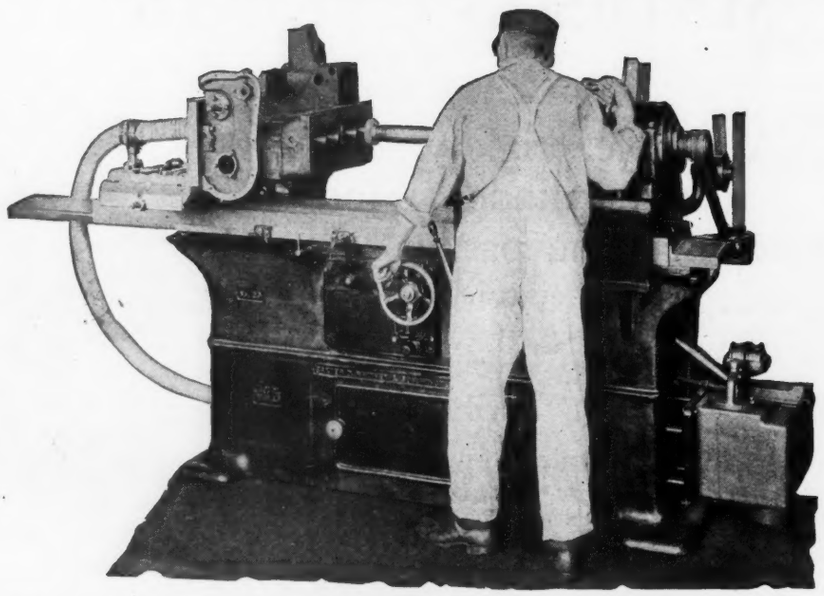
WHITNEY CYLINDER GRINDER

For grinding all kinds of gasoline engine cylinders as well as castings too large or too heavy to revolve.

Machines furnished to grind holes from 3" up to 7" diameter and 14" deep.

Also equipped to grind holes as large as 14" diameter and 20" deep.

Write for new catalog



BAXTER D. WHITNEY & SON, INC.

DOMESTIC AGENTS: E. A. Kinsey Co., Cincinnati, Ohio. Strong, Carlisle & Hammond Co., Cleveland, O., and Detroit, Mich. E. L. Essley Machinery Co., Chicago, Ill. The Motch & Merryweather Machinery Co., Pittsburgh, Pa. Machine Tool Engineering Co., New York City. Sherritt & Stoer Co., Philadelphia, Pa. Carey Mchy. & Supply Co., Baltimore, Md. W. H. Savage, Fitchburg, Mass. Colcord-Wright Mchy. & Supply Co., 1223-1229 North Broadway, St. Louis, Mo.

WINCHENDON MASS., U.S.A.

PACIFIC COAST AGENTS: Portland Machinery Co., Portland, Ore. Perine Machinery Co., Seattle, Wash. Pacific Tool & Supply Co., San Francisco, Cal. CANADIAN AGENTS: Canadian Fairbanks-Morse Co., Montreal, P. Q. FOREIGN AGENTS: Buck & Hickman, Ltd., London, England. Fenwick Freres & Co., Paris, France.

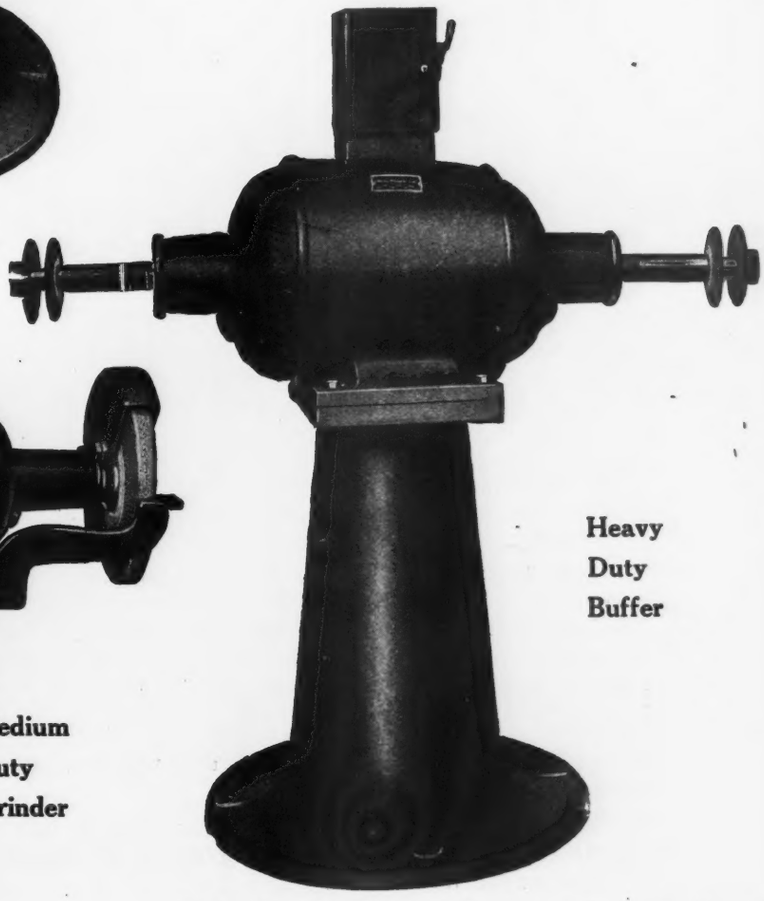


Medium Duty Buffer

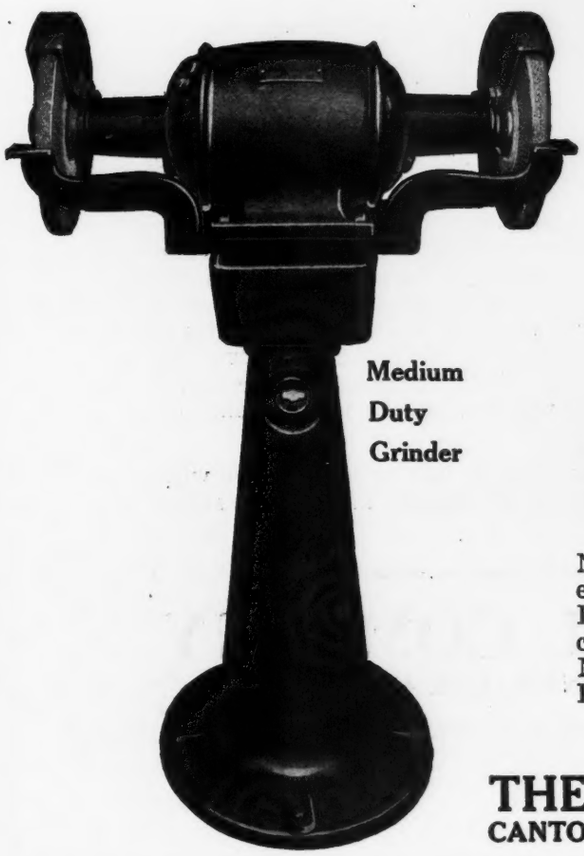
DILLON ELECTRIC GRINDERS and BUFFERS

Self-Contained — Ball Bearing
Dust Proof — Noiseless

Made for Either Direct or Alternating Current



Heavy Duty Buffer

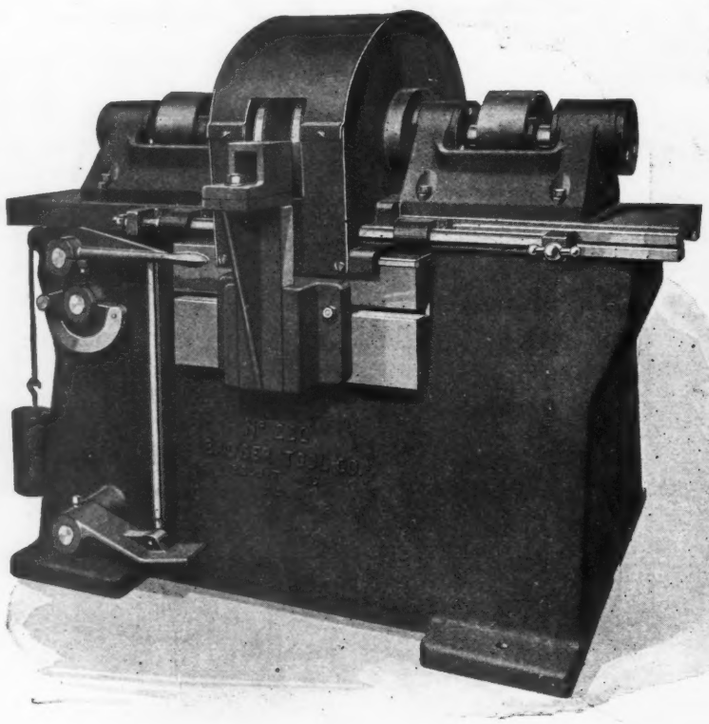


Medium Duty Grinder

Note the simplicity of design and elimination of excess parts.
Heavy Duty Machines made in 3, 5 and 7½ H. P. capacities.
Medium Duty Machines made in ½, 1 and 2 H. P. capacities.

Write for Details

THE DILLON ELECTRIC CO.
CANTON OHIO, U. S. A.



No. 220 Badger Grinder

There are a great many smaller parts having two opposite parallel faces which can be finished to size more economically on a double spindle disc grinder than by any other known process. Such parts, for example, as forged wrenches, piston rings, gear blanks, pliers, coil and leaf springs, carbon brushes, etc., etc. This work is being done successfully on Badger Grinders every day showing a marked saving in time and improved quality of finish. Parts which formerly could not be handled successfully on this type of grinder because of inaccuracy are now being finished to very close commercial limits on Badger Grinders.

We have incorporated in our double spindle type of machine many long needed features which make it possible to obtain very unusual results. Our special ball bearing spindle mountings; the long sliding ways absolutely protected against wear from grit; the unusual rigid base design and the positive micrometer stop make it practical to secure large outputs within very close limits. Angular adjustment of the heads allows the grinding of tapered surfaces as well as parallel. Abrasive cylinders held in chucks are interchangeable with disc wheels allowing wet grinding on parts requiring this treatment.

The No. 220 Badger Grinder can be furnished in belt or motor drive with complete dust exhaust system, wet grinding attachment and various styles of work supports.

Send samples to our Service Department for free demonstration grinding

BADGER TOOL COMPANY

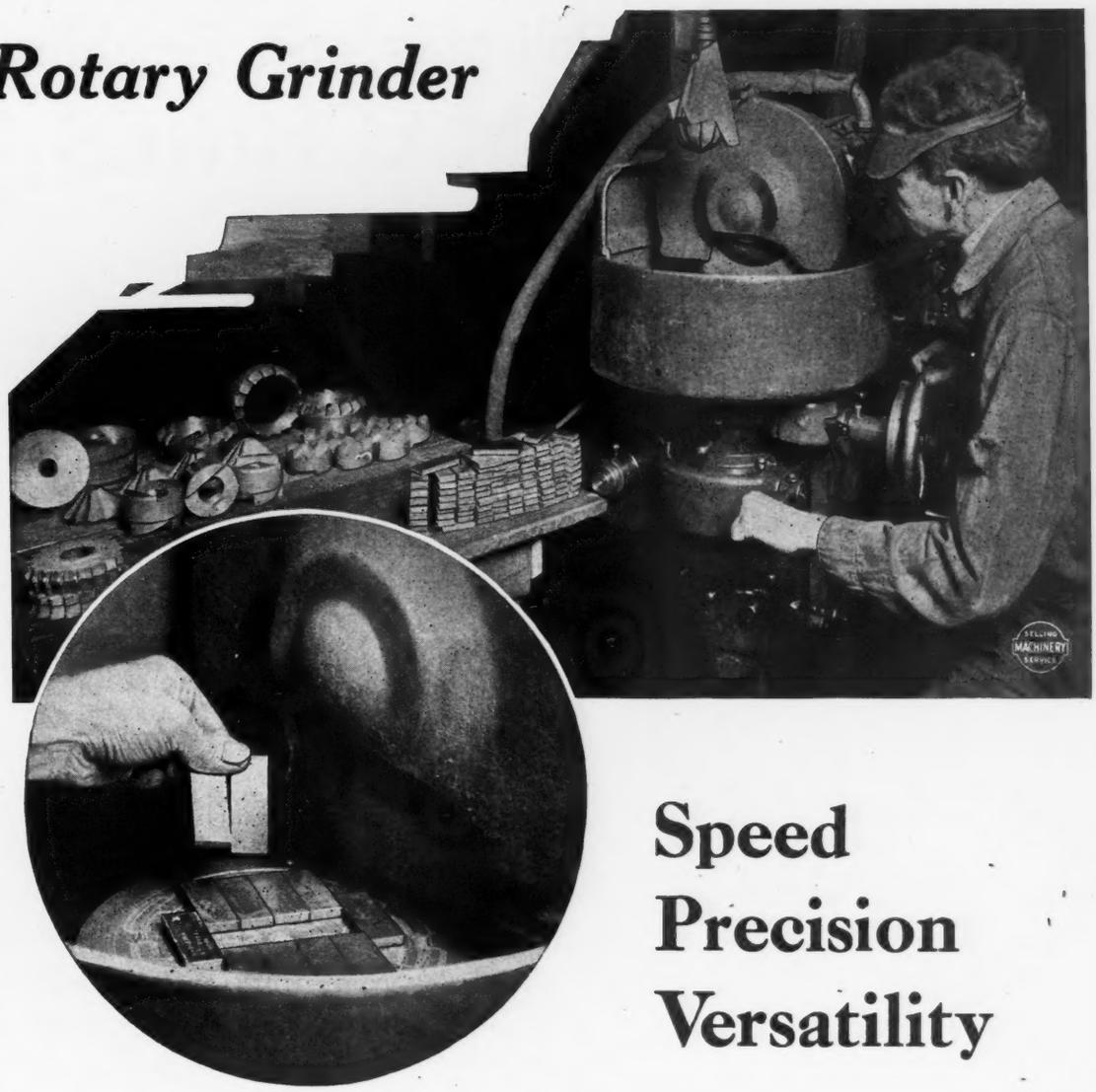
BELOIT, WISCONSIN, U. S. A.

E. B. GARDNER, President R. D. GARDNER, Treasurer

REPRESENTATIVES IN ALL PRINCIPAL CITIES AND FOREIGN COUNTRIES

PERSONS-ARTER

Rotary Grinder



Speed
Precision
Versatility

These three unquestioned attributes of the Persons-Arter Rotary Grinder are all advantageous on the type of work handled by the Gorham Tool Company, Detroit, Michigan.

Observe the varied work on the table; note the ten blades for inserted-tooth milling cutters on the magnetic chuck. These blades are 2½" x 1" x 5/16", both sides being ground.

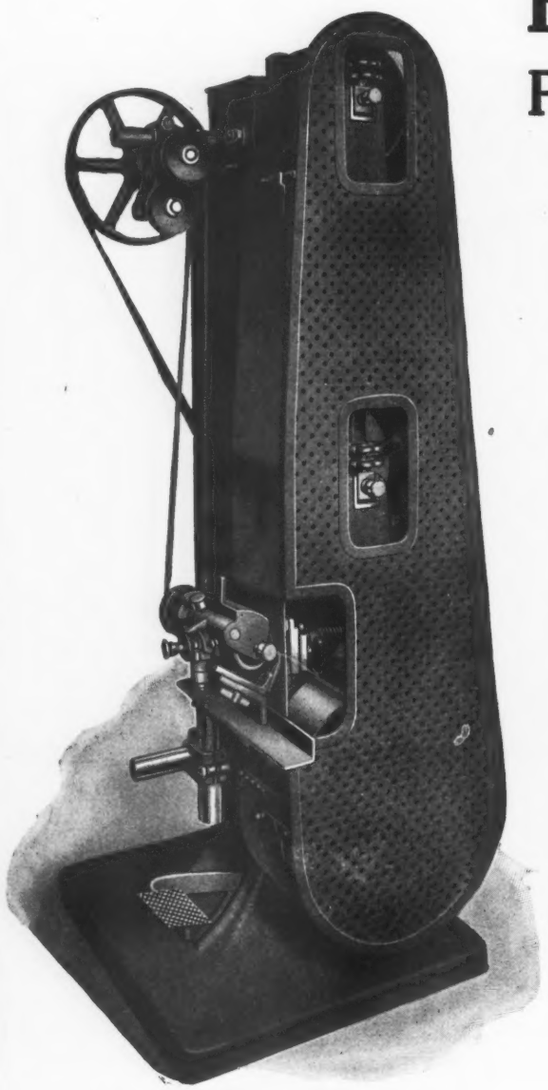
Despite the limits imposed—one-half thousandth of an inch—production averages 50 per hour. Three sizes: 8", 12", 16".

Write for complete data.

THE PERSONS-ARTER MACHINE CO.

72 Commercial Street **WORCESTER, MASS.**

PRODUCTION
Polishing and Finishing
MACHINES



Power Feed—Centerless
Completely Guarded for Safety

CUT CHIPS INSTEAD OF GRINDING DUST

Again we repeat, "it's the two-belt principle that does the trick"—a patented system which we own exclusively.

By means of this system we immediately dispose of the chips as they are generated or cut; after the belt passes the point where work is held it expels the chips and then resumes its normal position again.

Furthermore, cutting is substituted for grinding; minute machining for wearing, and the by-product is chips—instead of dust.

We will gladly send you complete details. Write for a "Production" estimate on your work—we'll show you speed as well as economy.



Above illustration shows chips magnified fourteen diameters

PRODUCTION MACHINE CO.

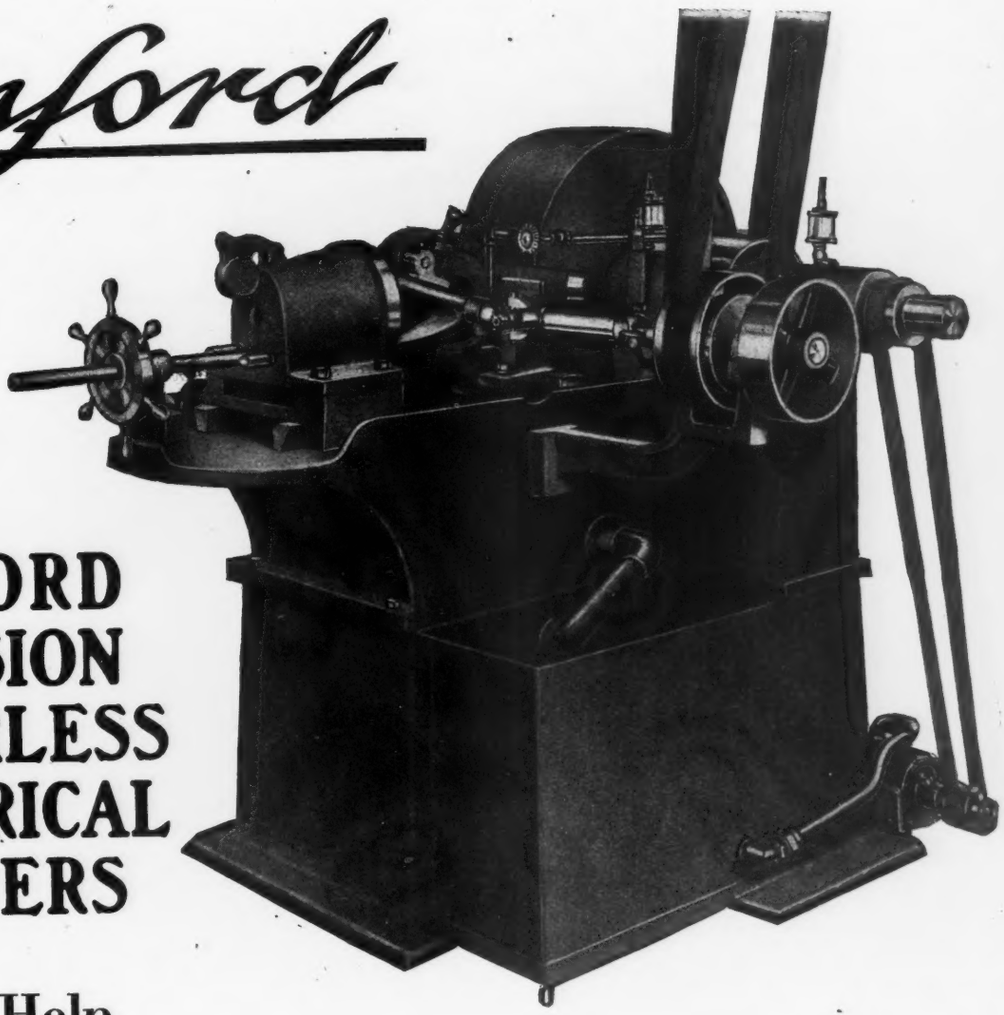
(Formerly Blevney Machine Company)

GREENFIELD MASS., U. S. A.

OVER-SEAS REPRESENTATIVE
ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA
31 CHAMBERS ST. NEW YORK, U.S.A.

CADILLAC TOOL CO. DODGE POWER BLDG., Detroit
FEDERAL MACHINERY SALES CO., Chicago, Milwaukee

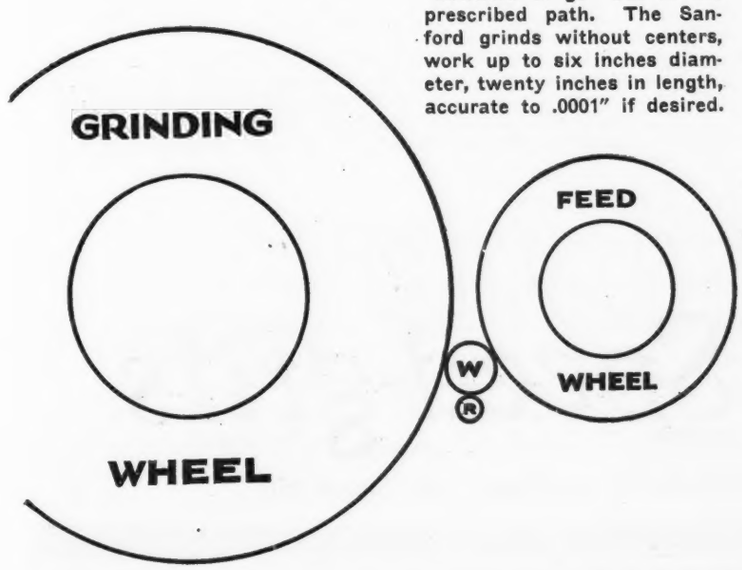
Sanford



SANFORD PRECISION CENTERLESS CYLINDRICAL GRINDERS

Just Can't Help Doing Accurate Work

The work W—travels on the cylindrical rest R—and has "nowhere to go" but in the prescribed path. The Sanford grinds without centers, work up to six inches diameter, twenty inches in length, accurate to .0001" if desired.



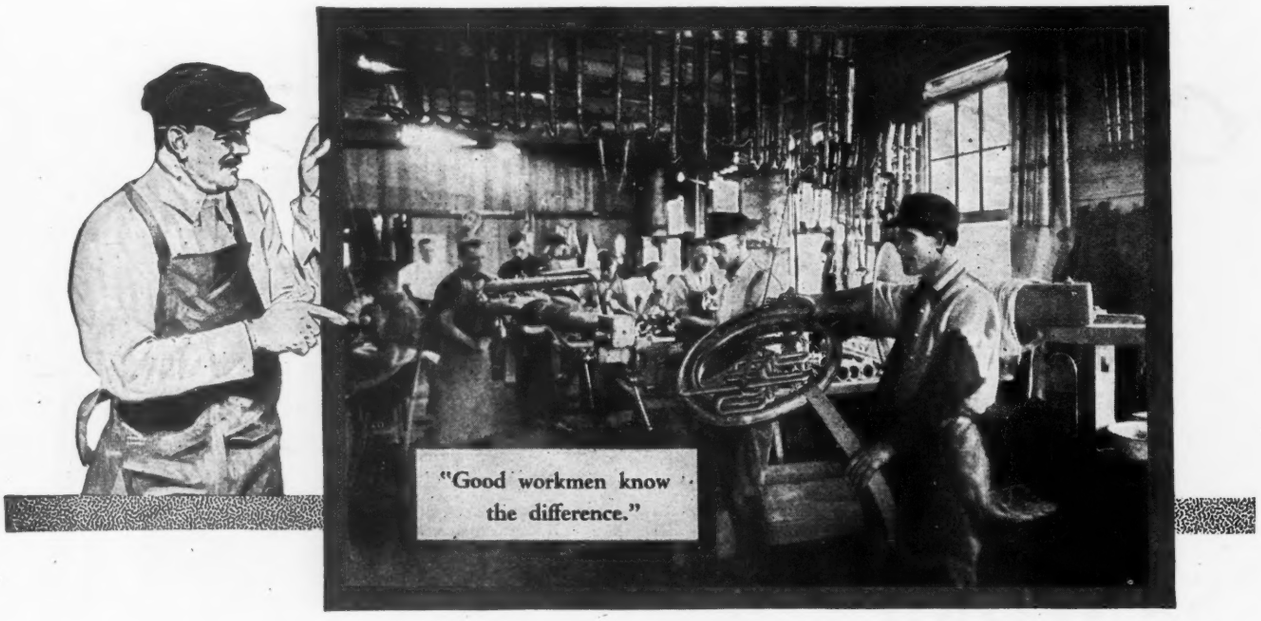
The remarkable and unusual accuracy of the Sanford Machine is due to the three-point contact between the grinding wheel, feed-wheel and cylindrical work rest. The result must be right. In fact the Sanford Precision Centerless Cylindrical Grinder can't help being accurate as the accompanying diagram shows.

The centerless method of cylindrical grinding has long been looked upon as the ideal system for big healthy production of cylindrical pieces. But, it was not until the advent of the Sanford that this system became practical and automatically adapted itself to modern shop practice.

Why not write for particulars?

RUSSELL, HOLBROOK & HENDERSON, Inc.

30 Church Street NEW YORK CITY



Why Schmidt Played Off Key

SQUAWK!

The Conductor rapped testily on the opened score and glared over at the brasses. (I was sitting in the back of a Broadway Movie Palace listening in on a rehearsal of the orchestra.)

The cornetist on his right—the alto saxophone player on his left—both stared accusingly at the red-faced Schmidt who sat looking at his new saxophone with a puzzled air.

"We're playing no Chinese scales this morning, Mr Schmidt," said the Conductor with heavy sarcasm. "If you'll please to stick to the music as written we'll go on with the rehearsal. Ready!"

My mind turned back to my last summer's trip through the Buescher Band Instrument Company's plant. I can't play two notes on a saxophone but from what I learned on that trip I knew what was wrong with Schmidt's saxophone.

* * * * * * * * *

"It's ticklish close work," said Mr. Lewis. "The mouthpiece of a saxophone has got to be right." We stood in the finishing room of the Buescher Band Instrument Company's big factory out in Elkhart, Indiana, where the famous Buescher True Tone band instruments are made. All around me workmen were putting the finest sort of finish on the gleaming brass and silver instruments with strips of fast cutting Speed-grits.

"You see," Lewis went on, "if the rubber mouthpiece of a saxophone is the least bit out of true—lower on one side than on the other—it will squeak and squawk—usually at the wrong time. And look here!" He took a trombone from one of the finishers.

"The slightest leak in the slide or joint of these fellows and their tone goes howling to the dogs. With Manning Speed-grits these parts are finished to less than one-thousandth of an inch.

"Accurate? We have to be. Think of our awful responsibility. Possible discords, you know. We make harmony here—nothing else."

Incidentally there's complete harmony between Buescher workmen and Speed-grits.

Good workmen know the difference.

Manning Speed-grits

Look for this trade-mark on the back of every sheet, belt or disc.

Write for "The Difference Book." Address the Manning Abrasive Co., Factory and Laboratory, Troy, N. Y. Sales offices in Boston, Chicago, Cincinnati, New York, Philadelphia, St. Louis, San Francisco, and other principal cities. Look for Manning Abrasive Co. in your telephone book.

Speed-grits

comes in the following varieties:
GARNET PAPER
GARNET CLOTH
GARNET COMBINATION
FLINT PAPER
EMERY CLOTH
EMERY PAPER
METALITE CLOTH
HANDY ROLLS
GRINDING DISCS
DURITE CLOTH
DURITE PAPER
DURITE COMBINATION
DURUNDUM PAPER
DURUNDUM CLOTH

Manning
Speed-grits
Reg.U.S.Pat.Off.

Don't say sandpaper—say Speed-grits

WALTHAM

CARBOWALT WHEELS

for Grinding Cast-iron Cylinders



State the details of your grinding requirements and we will show you what Waltham Grinding Wheels can do to speed up production in your plant.

In the grinding of cast-iron cylinders, fast work and high quality of finish are necessary. This was the problem that confronted the Wadell Motor Corporation, Newark, N. J., (where they repair anything from a motorcycle to a Packard, and keep four cylinder grinders busy).

They felt there must be a quicker method than the one they were using—and they found this quicker method by using Waltham Carbowalt Grinding Wheels.

A two months' trial of Waltham Wheels greatly increased cylinder grinding production without in any way lowering the quality of the finished work—and as a result, Waltham Grinding Wheels have been made "standard" for this work. It was found that a 3½" x ¾" x 1¼" 36s-J Carbowalt Wheel on a Heald machine was capable of removing more stock in a given time than any other grinding wheel this company had ever tried.

ALOWALT

CARBOWALT

WALTHAM GRINDING WHEEL CO.

WALTHAM, MASS., U. S. A.

Thompson Universal Grinders

Accurate, Wide Range Machines with Valuable Production Possibilities

Grinding broaches is a "particular" job, the accuracy of the broach decides the value of the entire broaching operation.

That's why—in this plant—they grind their broaches as well as all other special tools on a Thompson Universal Grinder. The ease with which this machine can be set up for internal, external or surface grinding, the accuracy with which it performs these varied operations, the operating conveniences that insure rapid production are all "economy" features that are important factors in deciding production costs.

The Thompson Universal Grinder has a capacity for cylindrical grinding 10″ in diameter to 36″ long; surface grinding 48″ by 8″; internal grinding to 12″ diameter and knife grinding to 48″ long. Adapted for grinding tapers up to 3″ per foot. An accurate, adaptable and economical machine.

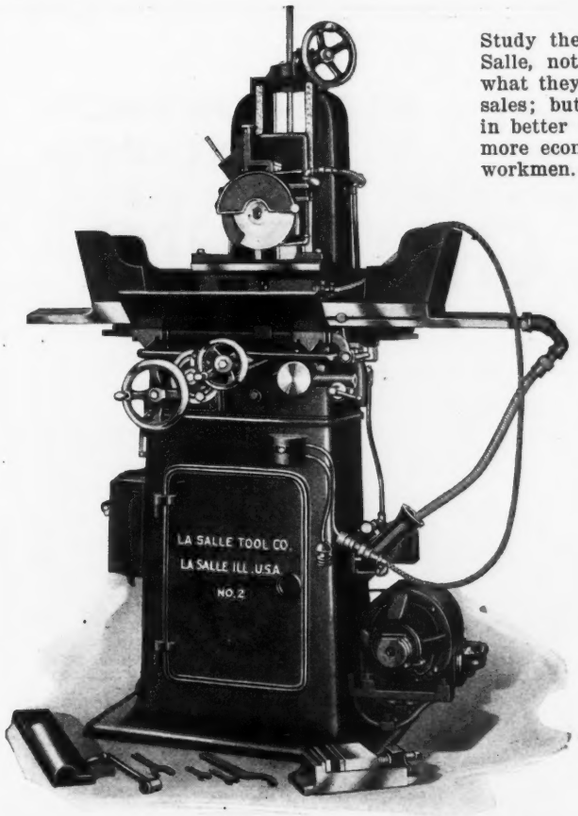
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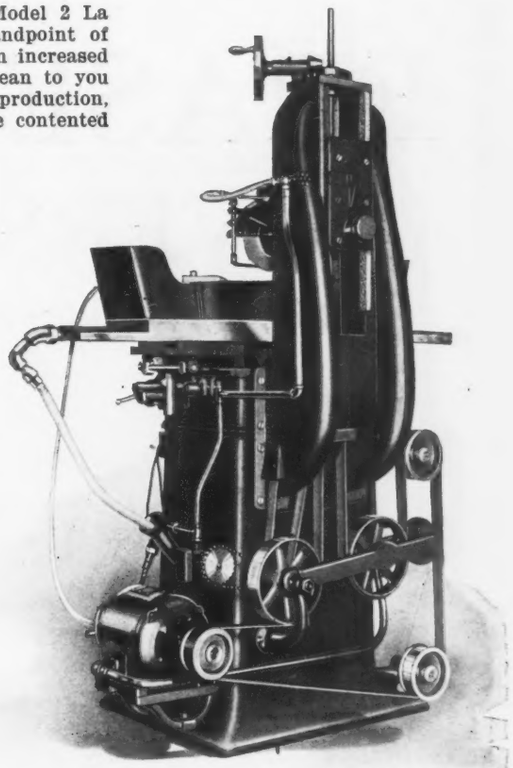
Photographed at the Gorham Tool Co., Detroit, Michigan

THE THOMPSON GRINDER COMPANY

SPRINGFIELD **OHIO, U.S.A.**



Study the features of Model 2 La Salle, not from the standpoint of what they mean to us in increased sales; but what they mean to you in better work, greater production, more economy and more contented workmen.



This Tool Gives Surface Grinding Satisfaction

MODEL 2 LA SALLE

(Capacity 20" x 6" x 10")

This many-featured La Salle Automatic Surface Grinder does its work with the greatest amount of satisfaction to the user because the working units are all practical and desirable features designed to make the La Salle as near perfect as is possible.

For grinding dies, punches and all varieties of small tools, you will find the La Salle does better work, increases production, is most economical and keeps the operator in a contented frame of mind. It will be found indispensable for many manufacturing jobs, finishing bright and true surfaces or parts of tools and instruments.

In this La Salle Model 2 there are featured fifteen practical working units, including: Direct motor drive, using 1½ H. P. motor, for either direct or alternating current; coolant control; wheel truing device, cast in one piece with wheel guard, enables operator to true wheel without disturbing work on table; special feature for preserving alignment, the most important point in a grinding machine.

The Model 2 Grinder can be furnished with a magnetic chuck. This chuck is supplied only on special order, and is not a part of the regular equipment.

We are also able to furnish 4-inch index centers for grinding taps, hobs and other milling cutters.

More complete particulars on request.

LA SALLE TOOL COMPANY
LA SALLE ILLINOIS, U.S.A.

LA SALLE

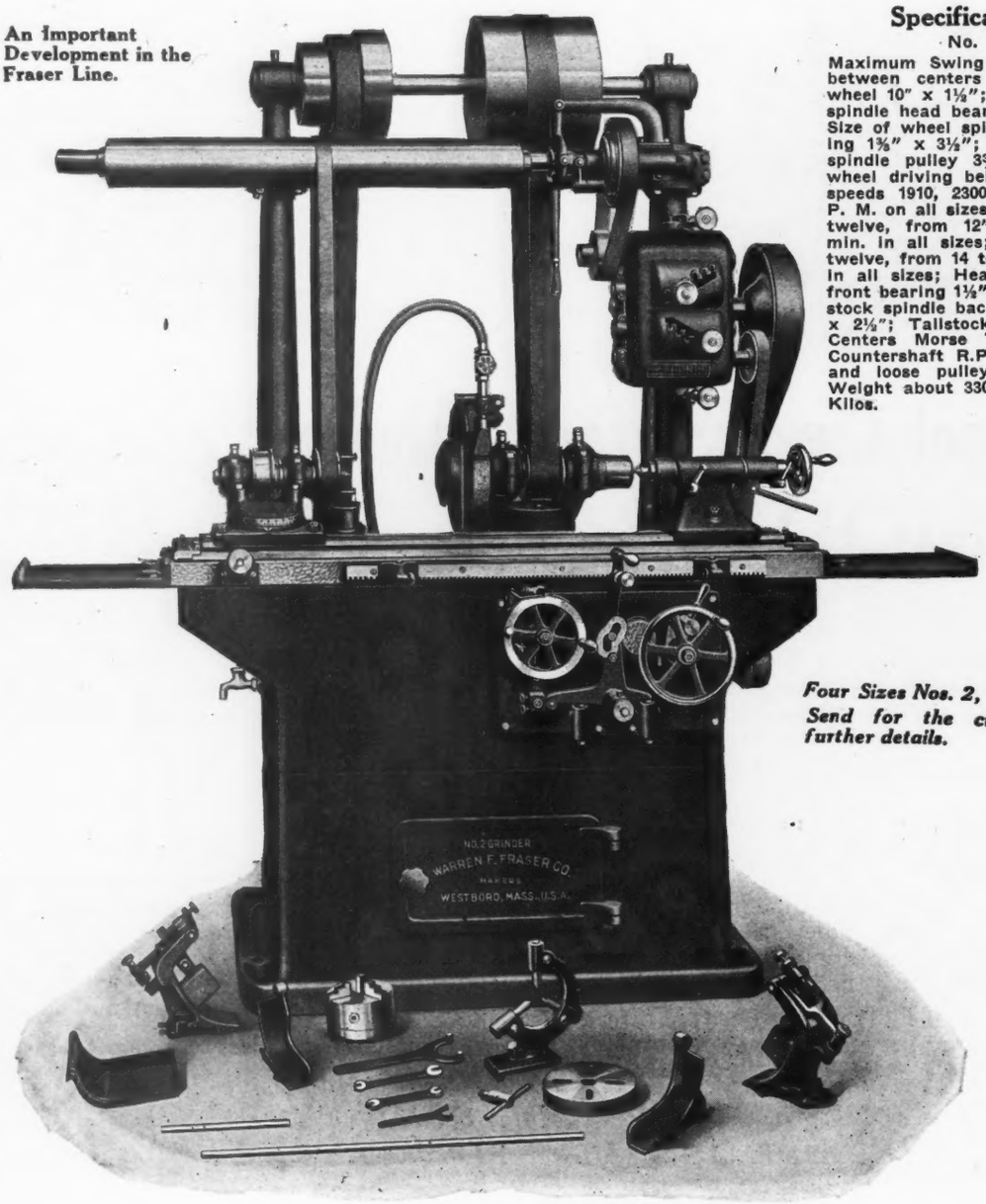
FRASER

HIGH-POWERED SELF-CONTAINED

UNIVERSAL GRINDER

The self-contained construction makes available a greater range of table and work speeds and permits the machine to be set up without the erection of overhead shafting, etc.

An Important Development in the Fraser Line.



Specifications

No. 2

Maximum Swing 11"; Distance between centers 30"; Size of wheel 10" x 1½"; Size of wheel spindle head bearing 1½" x 4"; Size of wheel spindle tail bearing 1⅜" x 3½"; Dia. of wheel spindle pulley 3¾"; Width of wheel driving belt 2½"; Wheel speeds 1910, 2300, and 2875 R. P. M. on all sizes; Table speeds twelve, from 12" to 235" per min. in all sizes; Work speeds twelve, from 14 to 279 R. P. M. in all sizes; Headstock spindle front bearing 1⅛" x 2½"; Headstock spindle back bearing 1¼" x 2½"; Tailstock spindle 1¼"; Centers Morse Taper No. 2; Countershaft R.P.M. 900; Tight and loose pulleys 2½" x 10" Weight about 3300 lbs., or 1497 Kilos.

Four Sizes Nos. 2, 2A, 3, 3A. Send for the circular for further details.

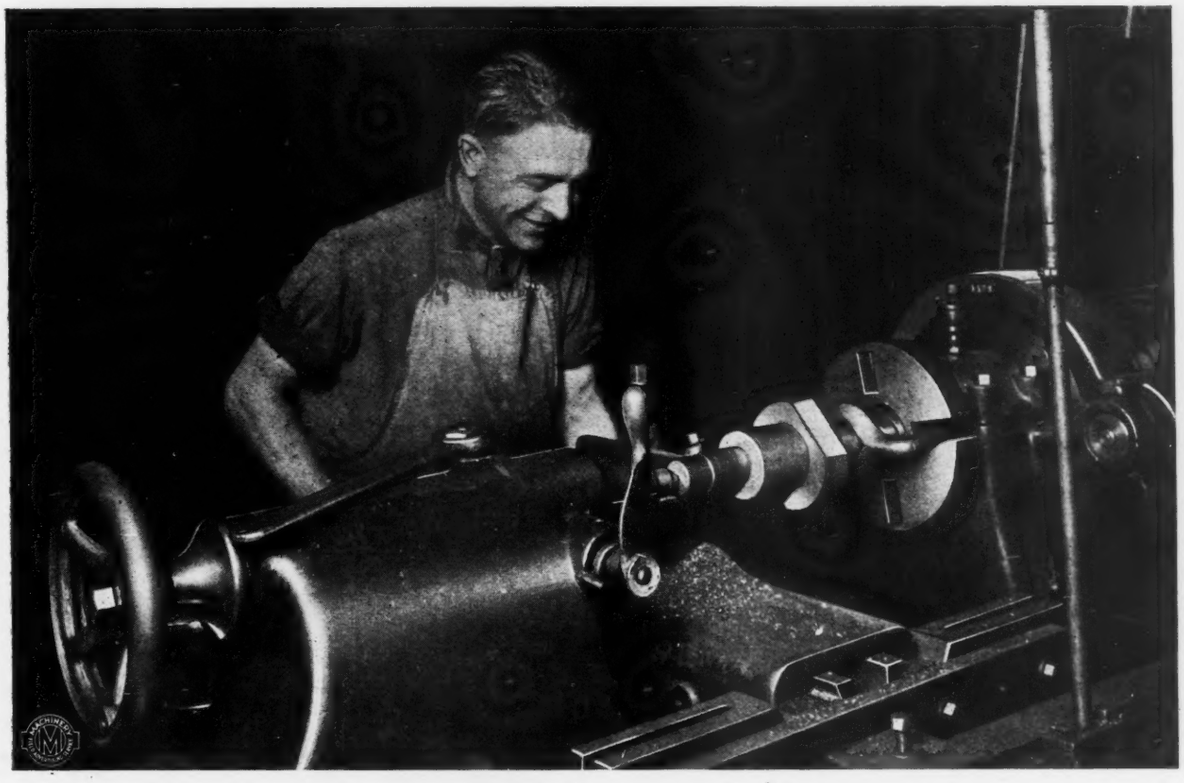
WARREN F. FRASER COMPANY

Westboro, Massachusetts

THE SIDNEY MACHINE TOOL COMPANY

SIDNEY LATHES

Machines Built to Traditional Standards



"Sidney Lathes are very accurate." The fact that this endorsement comes from a builder of high class machine tools—always the most discriminating class of judges—gives it more than ordinary weight and significance.

The Moline (Ill.) Tool Company, which holds this favorable opinion, owns two Sidney Lathes, the oldest installed more than eight years ago. One of them is shown turning a spindle adjusting head for the famous "Hole Hog" Cylinder Boring Machine—an operation requiring a high degree of accuracy and a fine finish.

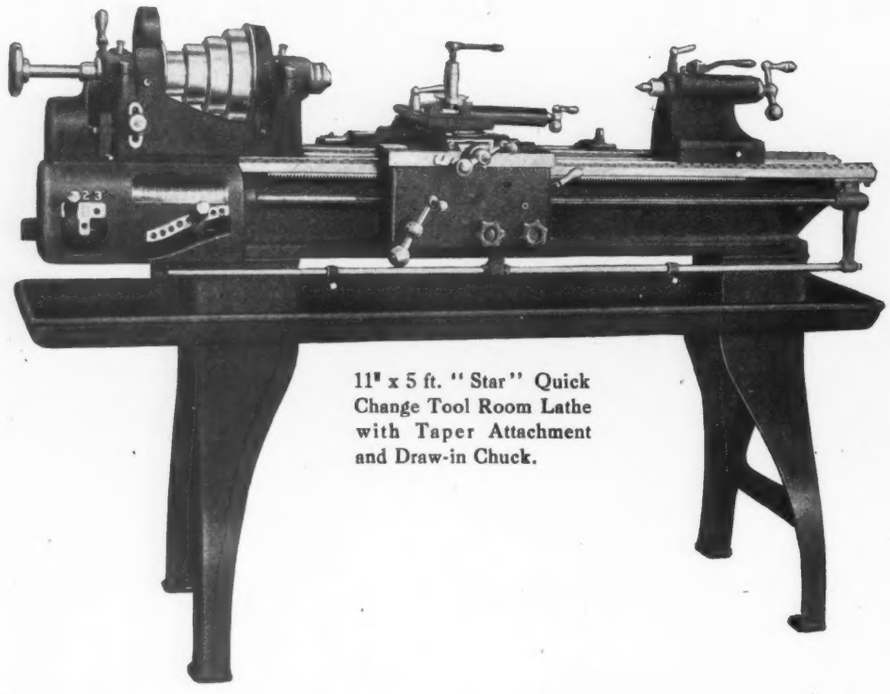
The record of "Sidney-for-Service" Lathes is one of achievement. Designed and built by men with long experience in machine building—men who put reputation before profits—they had exclusive operating conveniences and structural advantages which made them pioneers in their class. And these accurate, wide range machines have consistently maintained their leadership, were pace makers during the late war and are constantly setting new standards for quality, quantity and cost of output under modern methods of duplicate manufacturing.

Complete description of the "Sidney-for-Service" line on request.

THE SIDNEY MACHINE TOOL CO.

SIDNEY **OHIO, U. S. A.**

"STAR" LATHES

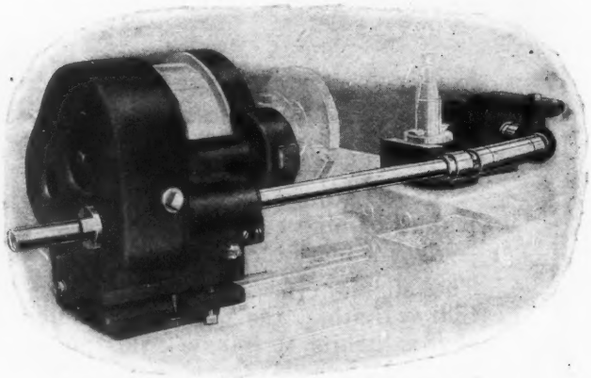


11" x 5 ft. "Star" Quick Change Tool Room Lathe with Taper Attachment and Draw-in Chuck.

For People Who take a Pride In their Toolrooms

STAR LATHES

Closer limits and the necessity for more careful work without lowering production have created a need for better tools. The attainment of this end is only possible if the toolroom equipment is beyond reproach. It is not economical to put small parts in a large lathe—equipment should be adapted to the work. "Star" Lathes are built for people who take a pride in their equipment, and sell for a price you are willing to pay. Cut shows the 11" x 5' "Star" Quick Change Toolroom Lathe. Write for complete list.

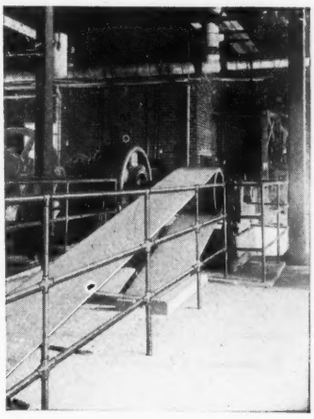


Relieving attachment for Star Lathes

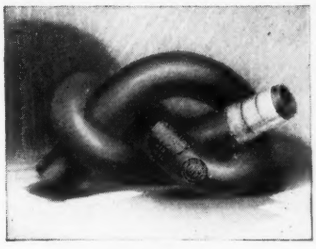
The "Star" Relieving attachment is used for accurately backing off a large variety of milling cutters, end mills, reamers, etc. Stroke is adjustable while machine is in motion to give any amount of relief from 0" to ⅛", amount being indicated by graduations. Order your attachment with lathe, or separately if you are equipped with former.

THE SENECA FALLS MFG. COMPANY, Inc.

381 FALL STREET SENECA FALLS, NEW YORK



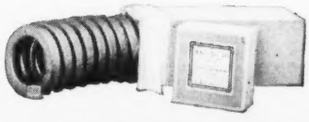
Rainbow Belt



4810 Air Hose



Rainbow Steam Hose



Rainbesto Rod Packing

Rubber Goods For All Industries

THE mill supply salesmen and the practical factory men of the United States Rubber Company are qualified through study and experience to recommend the right mechanical rubber goods for any condition existing in this industry.

They are ready to assist mill operators by advising as to the best application of mechanical rubber goods in order that the greatest possible service may be obtained for every dollar invested.

United States Rubber Company

The World's Largest and Most Experienced Manufacturer of Mechanical Rubber Goods

Transmission *"Rainbow," "Pilot" "Shawmut"–"Giant Stitched"*
Conveyor *"United States," "Grainster"*
Elevator *"Matchless" "Granite," "Grainster"*
Tractor *"Sawyer Canvas" "Little Giant Canvas"*
Agricultural *"Rainbow," "Bengal" "Grainster," "Sawyer Canvas"*

Air *"4810," "Dexter"*
Steam *"Rainbow," "Giant," "Perfected"*
Water *"Rainbow," "Mogul," "Perfected"*
Suction *"Amazon," "Giant"*
Garden *"Rainbow," "Mogul," "Lakeside"*
Also Hose for Acetylene, Oxygen, Acid, Air Drill, Auto Radiator, Car Heating, Air Brake, Gasoline, Oil, Hydraulic, Chemical, Coke, Creamery, Discharge, Vacuum, Sand Blast, Spray, etc

Sheet *"Rainbow," "Vanda," "Paramo"*
Rod *"Wizard," "Rainbesto," "Peerless," "Honest John," "No 573" and hundreds of other styles in coils, rings, gaskets and diaphragms —*
Usco Valves —
THE RIGHT PACKING IN THE RIGHT PLACE

Mats, Matting and Flooring, Plumbers' Specialties, Rubber Covered Rolls, Friction Tape, Splicing Comp'd. Dredging Sleeves, Hard Rubber Goods, Printers' Blankets, Tubing, Soles, Heels, Jar Rubbers, Moulded Goods

UNITED STATES RUBBER COMPANY
US
RUBBER SYSTEM
AND ASSOCIATED COMPANIES

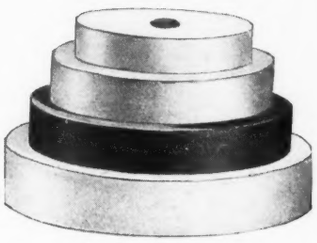
Rubber Goods For All Industries

BEING in close touch with the trade and with each other, our salesmen and factory men are able to combine their experience for the benefit of our customers, large or small.

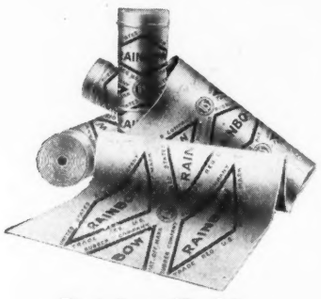
Take advantage of this Company's facilities and experience when in the market for rubber goods. Through our nearest Branch you can obtain the fullest co-operation of our organization.



Sawyer Conveyor Belt



Pump Valves



Rainbow Packing



Perfected Water Hose

United States Rubber Company

The World's Largest and Most Experienced Manufacturer of Mechanical Rubber Goods

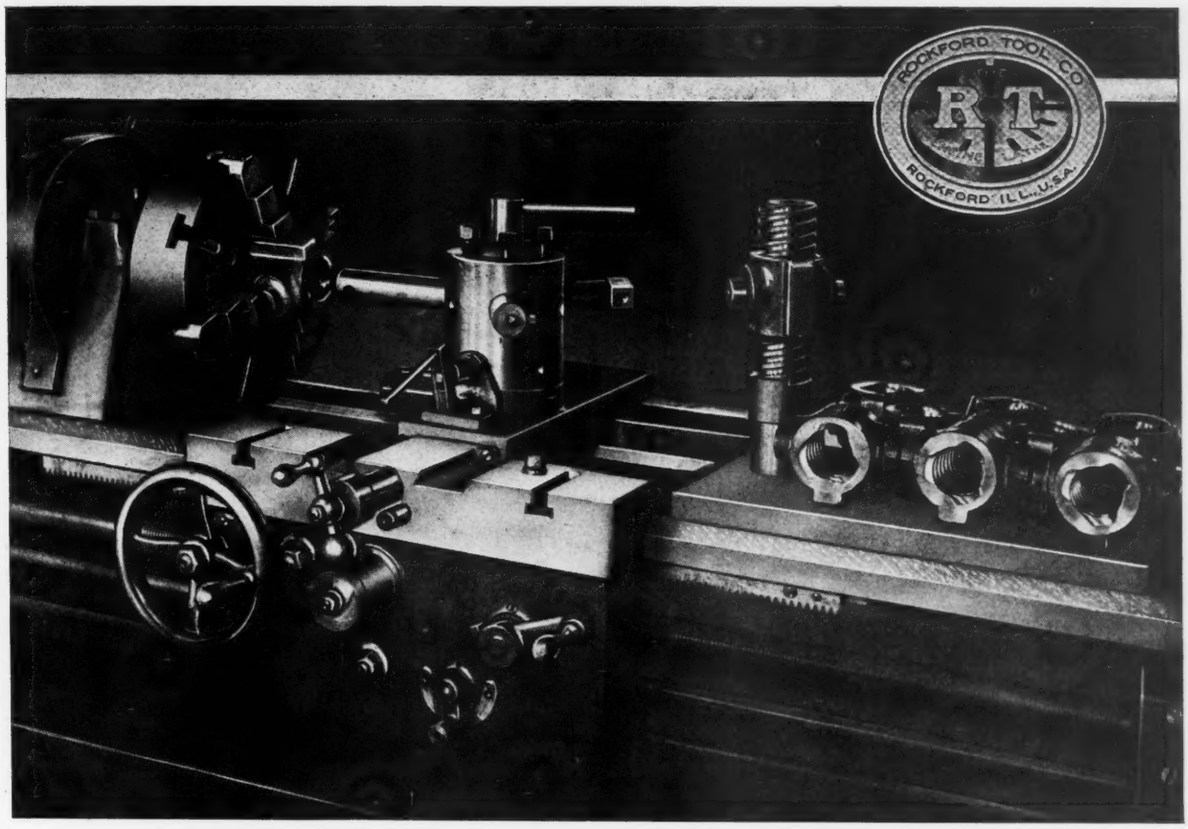
Transmission *"Rainbow," "Pilot" "Shawmut"–"Giant Stitched"*
Conveyor *"United States," "Grainster"*
Elevator *"Matchless" "Granite," "Grainster"*
Tractor *"Sawyer Canvas" "Little Giant Canvas"*
Agricultural *"Rainbow," "Bengal" "Grainster," "Sawyer Canvas"*

Air *"4810," "Dexler"*
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Suction *"Amazon," "Giant"*
Garden *"Rainbow," "Mogul," "Lakeside"*
Also Hose for Acetylene, Oxygen, Acid, Air Drill, Auto Radiator, Car Heating, Air Brake, Gasoline, Oil, Hydraulic, Chemical, Coke, Creamery, Discharge, Vacuum, Sand Blast, Spray, etc

Sheet *"Rainbow," "Vanda," "Paramo"*
Rod *"Wizard," "Rainbesta" "Peerless," "Honest John," "No 573" and hundreds of other styles in coils, rings, gaskets and diaphragms —*
Usco Valves —
THE RIGHT PACKING IN THE RIGHT PLACE

Mats, Matting and Flooring, Plumbers' Specialties, Rubber Covered Rolls, Friction Tape, Splicing Comp'd, Dredging Sleeves, Hard Rubber Goods, Printers' Blankets, Tubing, Soles, Heels, Jar Rubbers, Moulded Goods

UNITED STATES RUBBER COMPANY
US
RUBBER SYSTEM
AND ASSOCIATED COMPANIES



"Locomobile" Steering Nuts—Faced, Bored and Threaded on This 15-Inch "SUNDSTRAND"

Indorsement?

How About This—

Machine, work and set-up are clearly shown in the accompanying photograph furnished by the Alling-Lander Company, Inc., of Sodus, N. Y., whose letter is here quoted to explain the operation.

" . . . Material is phosphor bronze and the thread 1½" lead, triple, right-hand Acme. The lead screw was driven from the headstock in the usual way at a speed of 327 R.P.M. Time required to face one end, rough and finish bore and thread these parts was 22 minutes each, and the lathe made no more fuss or noise than if it were doing a light turning job.

"We manufacture these nuts for the Locomobile Company of America, so it is needless to mention the accuracy with which they must be machined. We have no other lathe in our shop that . . . would handle this work as economically and accurately as this Rockford . . ."

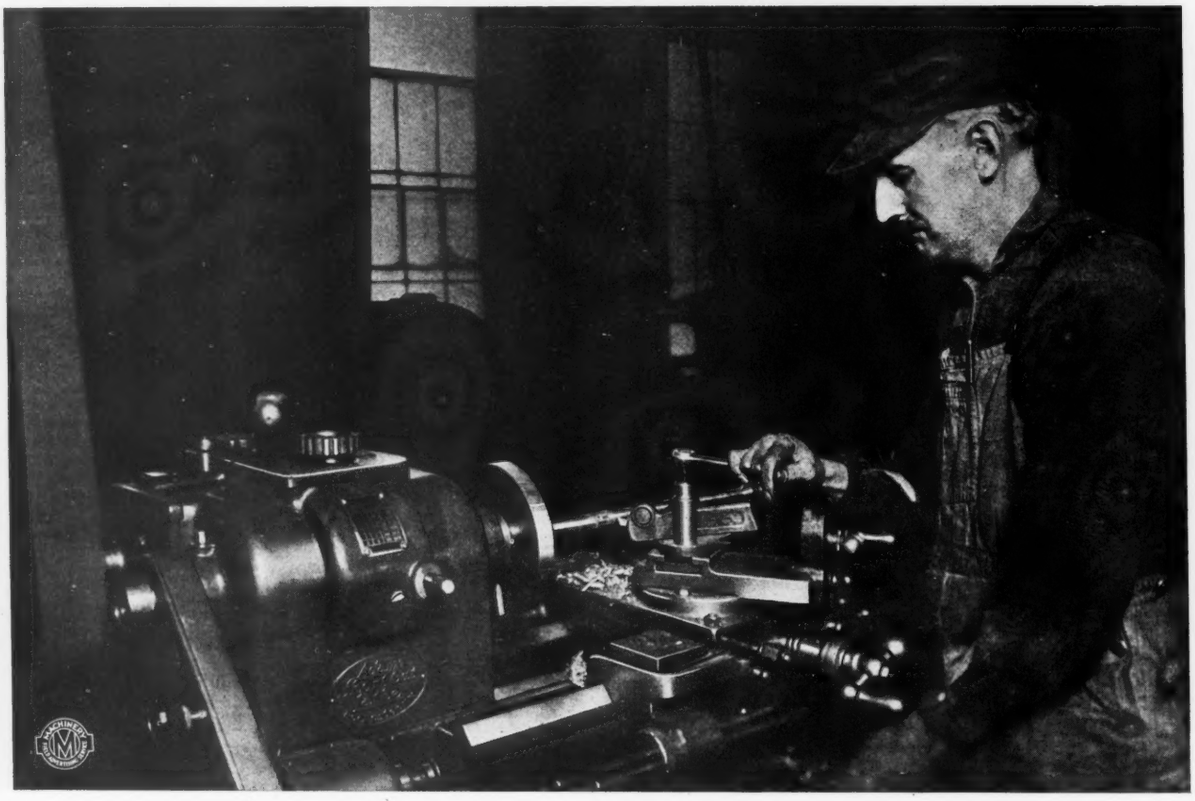
If the above endorsement interests you we'll be glad to tell you more about the machine.

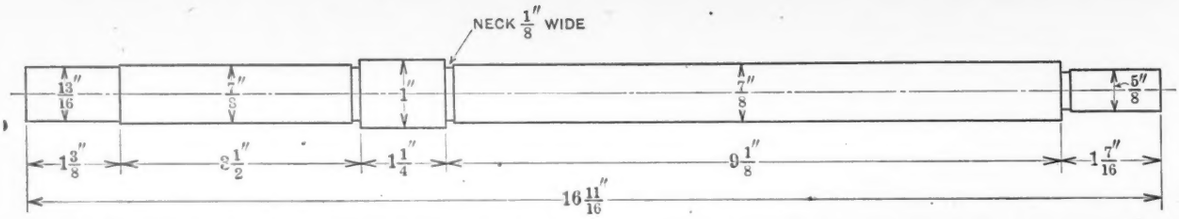
ROCKFORD TOOL CO.

2502 Eleventh St. **Rockford, Ill.**

FOREIGN DEALERS: Aktiebolaget Rylander & Asplund, Stockholm, Sweden; A. A. Jones & Shipman, Ltd., New Century Works, Leicester, England. Societa Anonima, Adler & Co., Milano, Italy. R. S. Stokvis & Zonen, Ltd., Rotterdam, for Holland, Belgium and France.

The Adams





One of the most interesting things about the Adams "Short-Cut" Lathe is the number of diversified industries it is entering. Here we see it in the plant of a big machine tool builder. Why did they adopt it? No secret about it—simply a matter of dollars and cents.

The Adams "Short-Cut" Lathe is made for the average job. When you put the average job in a heavy engine lathe, you are not only wasting power, wasting time and wasting a big proportion of your lathe investment, but you're losing in accuracy. The photograph shows an Adams "Short-Cut" Lathe at work on a back gear shaft for a shaper, dimensions of former being shown in sketch. These shafts, made from 1″ cold rolled steel, are turned out in six operations as follows; Face ends to length, cut three necks 1/8″ wide to give clearance for the wheel when grinding, turn the 7/8″ diameter 9 1/8″ long, leaving .012″ to grind, turn the 7/8″ diameter 3-1/2″ long, leaving a like amount to grind,

O. R. ADAMS MANUFACTURING

AGENTS: Ogden R. Adams, Rochester, Syracuse, Buffalo; Fairbanks Co., Boston, New York, Baltimore, Philadelphia, Washington, Chicago; W. M. Pattison Supply Co., Cleveland, Ohio; Gang Machinery Co., Cincinnati, Ohio; National Supply

"Short-Cut" Lathe

Adams Short Cut lathe Rochester, N.Y.

TRADE MARK REGISTERED

Successfully Takes Over Much of the Work of Heavy Engine Lathes, Giving Greater Speed, Convenience and Economy

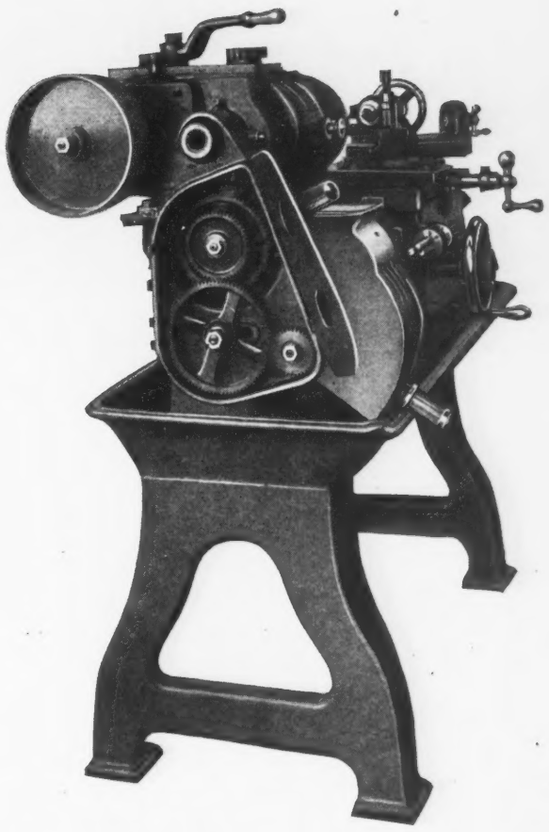
Write for full details of this up-to-date lathe and see what it will do for you.

turn the 13/16" to size, and lastly turn the 5/8" diameter, leaving as before .012" to grind.

It takes only twenty-five hours to turn out the full batch of 100 shafts; in other words, fifteen minutes for each.

The Adams "Short-Cut" Lathe is enormously powerful, and having all the features of a standard engine lathe doesn't need a specially trained operator. It has six speeds which can be changed without stopping. Thrust of steel spindle is taken on S.K.F. self-aligning ball bearings. A wide range of speeds is easily made. Every detail has been so carefully thought out that maximum efficiency is predetermined.

One of the most interesting features of the Adams "Short-Cut" Lathe is the TAPER ATTACHMENT, which can be supplied if desired. This is fastened to bed in planed T-slots so that carriage carries no extra weight except that of taper extension arm. Tapers up to 1½" per foot can be cut the whole length between centers.



CO., Inc., Norton Street, Rochester, N. Y.

Co., Toledo, Ohio; Herberts Machinery & Supply Co., Los Angeles, Cal.; Allied Machinery Co., France, Belgium, Spain and Italy.



PORTER-CABLE LATHES

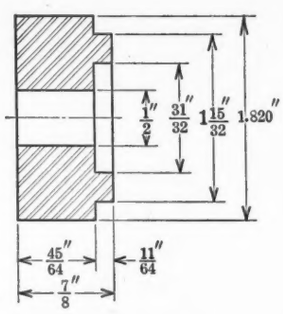
"Fill the Broad Need for Precision and Speed"

It is nearly three years since this rapid and versatile producer was installed in the Cincinnati-Bickford Co.'s model shop. It is used extensively for second operation work—turning small gears, collars, studs, etc., which have been previously roughed out on the big automatics. The sketch below indicates the close dimensions to which it machines and the micrometer on the end of the bed in the accompanying illustration shows how rigidly they are maintained.

Machine Steel Clutch Gear Blanks—Four Minutes Each.

This output is excellent, for the stock is tough and the piece is machined all over which necessitates turning it around on the arbor after the back is faced, the total schedule of operations being as follows: First, face back; second, turn blank around on arbor and turn outside diameter—removing 1/32″ of stock; third, face front to dimensions; fourth, turn small diameter and face shoulder.

Output, as above stated, is uniform—four minutes each, fifteen per hour. If this class and quality of service interests you, we'll be glad to send details of the machine.



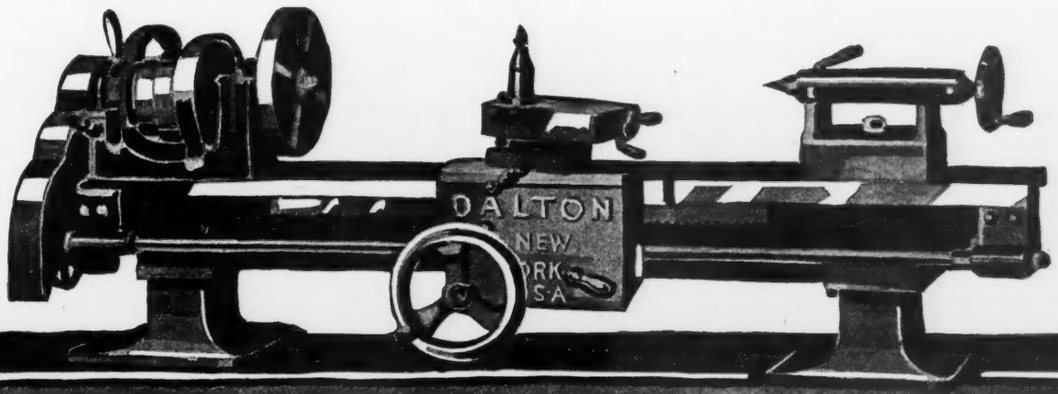
SMALL CLUTCH GEAR BLANK

MACHINE STEEL

THE PORTER-CABLE MACHINE COMPANY

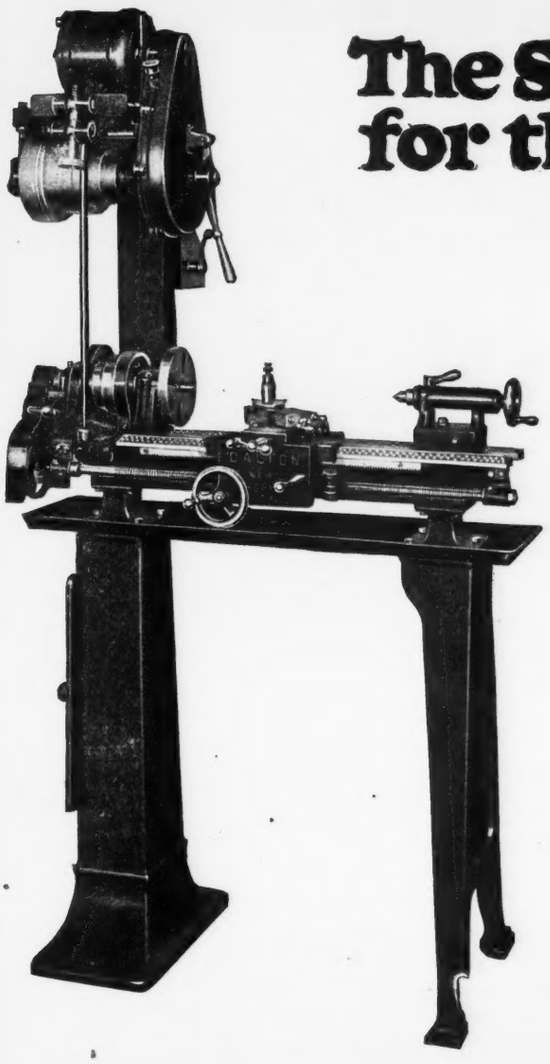
Syracuse, New York, U. S. A.

AGENTS: Barkour, Love & Woodward, Inc., New York City; Colcord-Wright Machinery & Supply Co., St. Louis; E. L. Essley Machinery Co., Chicago and Milwaukee; Pacific Tool & Supply Co., San Francisco and Los Angeles; Chas. A. Strelinger Co., Detroit; Strong, Carlisle & Hammond Co., Cleveland; Syracuse Supply Co., Syracuse, Buffalo and Rochester; Vonnegut Machinery Co., Indianapolis; Harold A. Wright, 201 Devonshire Street, Boston; Luster Mchy. Co., Philadelphia, Pa.; EXPORT REPRESENTATIVE: Benjamin Whittaker, Inc., 21 State St., New York City; Vulcan House, 56 Ludgate Hill, London, E. C.; Fenwick Freres & Co., Paris, Barcelona, Liege, Turin, Zurich; Burton, Griffiths & Co., London; Bevan & Edwards Pty., Ltd., Melbourne; R. S. Stokvis & Zonen, Ltd., Rotterdam; Yamatake & Co., Tokyo; V. Lowener's Maskinforretning, Sverre Mohn, Christiania; Aktibolaget V. Lowener, Stockholm; V. Lowener, Copenhagen.



"DALTON SIX"

Type B-4-Actual Swing 7¼ Inches



The Small Lathe for the Big Job

DIRECT or alternating current supplied.

Motor runs in one direction. Spindle reverses for thread cutting.

Length of bed 30 or 36 inches.

Collet capacity 1-2" or 13 M. M.

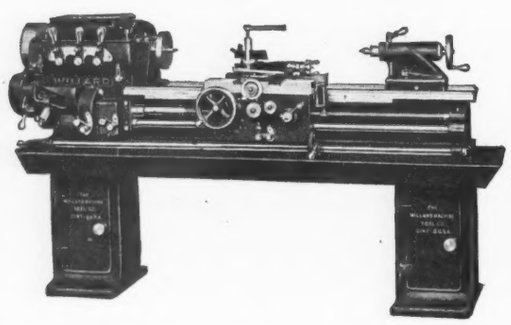
Write for Bulletin B-652

DALTON
Manufacturing Corporation
SOUND BEACH, CONN., U. S. A.
Cable Address: "Aledal, New York"

WILLARD



Seventeen Willard Lathes in the East Springfield Plant of the Westinghouse Electric & Mfg. Co.



Willard High Power Toolroom Lathes have steel gears throughout, ball bearings liberally used and any of 12 speeds instantly available. Further details on request.

The work shown is a rear bracket for the frame of an automobile starting motor. Material is cast iron, and two operations are performed. The first to turn the shoulder on the bracket to fit the motor frame, the second to turn the side of the bracket. Owing to the power and convenience of the Willard Lathe, on which these operations are performed, output is 800 brackets per 9¾-hour day.

This machine, in company with every other machine in the plant, including the other 16 "Willards," is equipped with Westinghouse Motors.

THE WILLARD MACHINE TOOL CO.

A STREET, BOX 784

Cincinnati Ohio, U. S. A.

PITTSBURGH

Simplicity and Power Are Outstanding In this 36-inch Double Front Geared Lathe

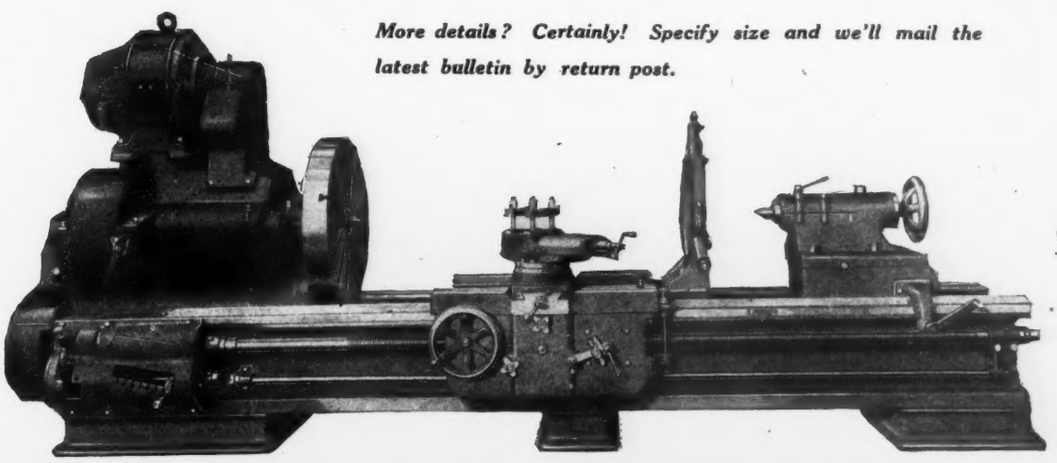
Wherever a D. C. drive is practicable, this powerful and simple engine lathe is the logical choice for heavy duty turning within its range.

Gearing at front of head instead of the usual back gearing, eliminates the lifting action on the spindle under cut, and facilitates gear shifting. Spindle is a 6″ diameter forging of high carbon, open hearth steel, 8″ long on front bearing with a 2¼″ hole through its entire length and large, self-oiling bearings of 6-1 copper and tin.

Apron is rigid, double plate type regularly furnished with all Pittsburgh Lathes, its studs and shafts casehardened, ground and provided with double bearings. Leadscrew is splined its full length and a long key in the lateral feed gear rides in this spline, driving all feeds except for thread cutting.

Design, material and workmanship of the tailstock, carriage and taper attachment are quite in keeping with the rest of the machine which is guaranteed to bore straight and face square within .001″ per foot.

More details? Certainly! Specify size and we'll mail the latest bulletin by return post.

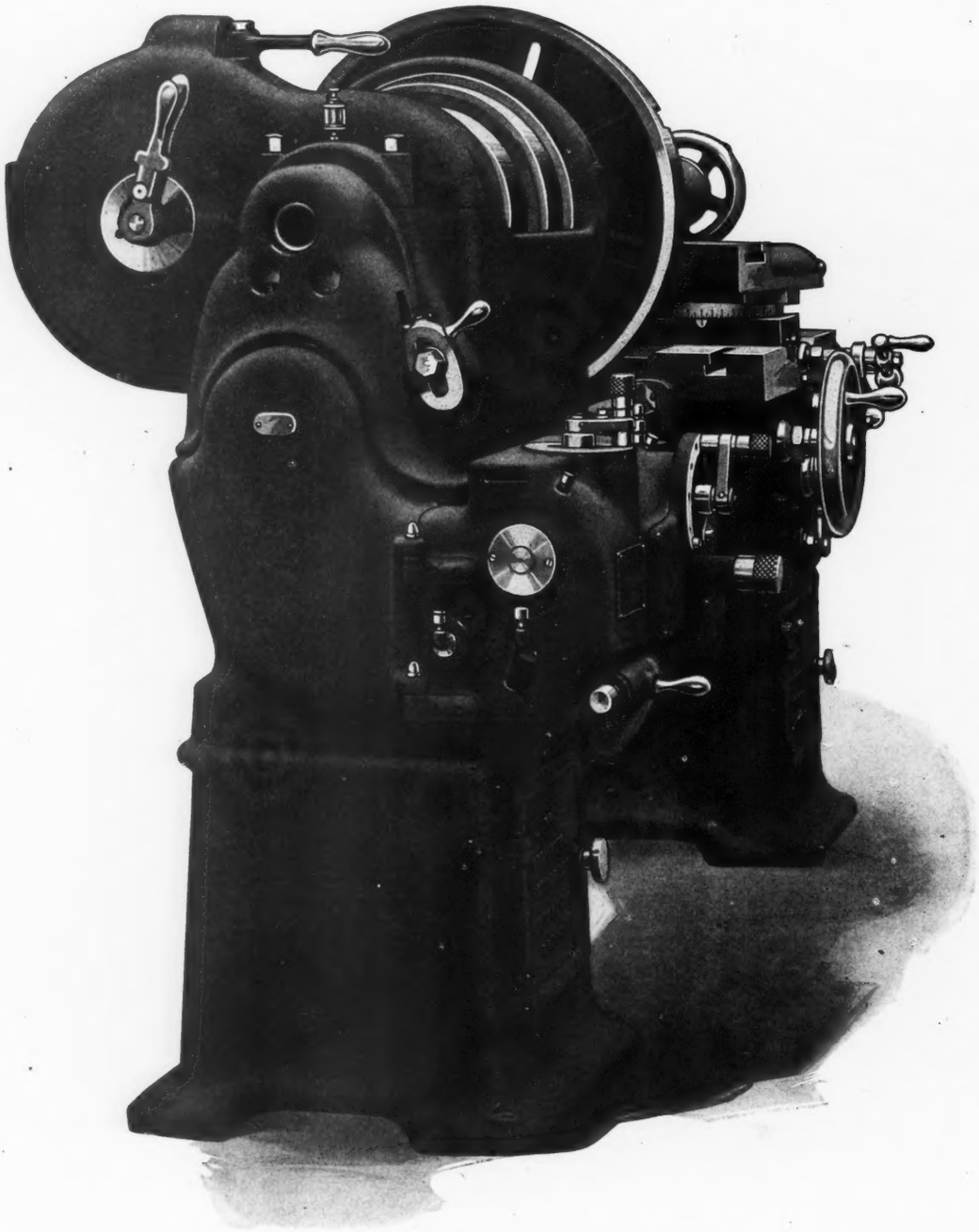


PITTSBURGH MACHINE TOOL CO.

Braddock, Pa., U. S. A.

Eccles & Smith Co., Seattle, Wash.
Swind Machinery Co., Philadelphia, Pa.
Backer Machine Tool Supply Co., New York.
Harold A. Wright, 201 Devonshire St., Boston, Mass.
Wm. C. Johnson & Sons, St. Louis, Mo.
Wolverine Machinery & Supply Co., Detroit, Mich.
Thompson Machinery Co., Pittsburgh, Pa.
Eccles & Smith Co., Portland, Ore.
Hendey Machine Co., Chicago, Ill.

New Type 20" Instantaneous Change Gear Engine Lathe

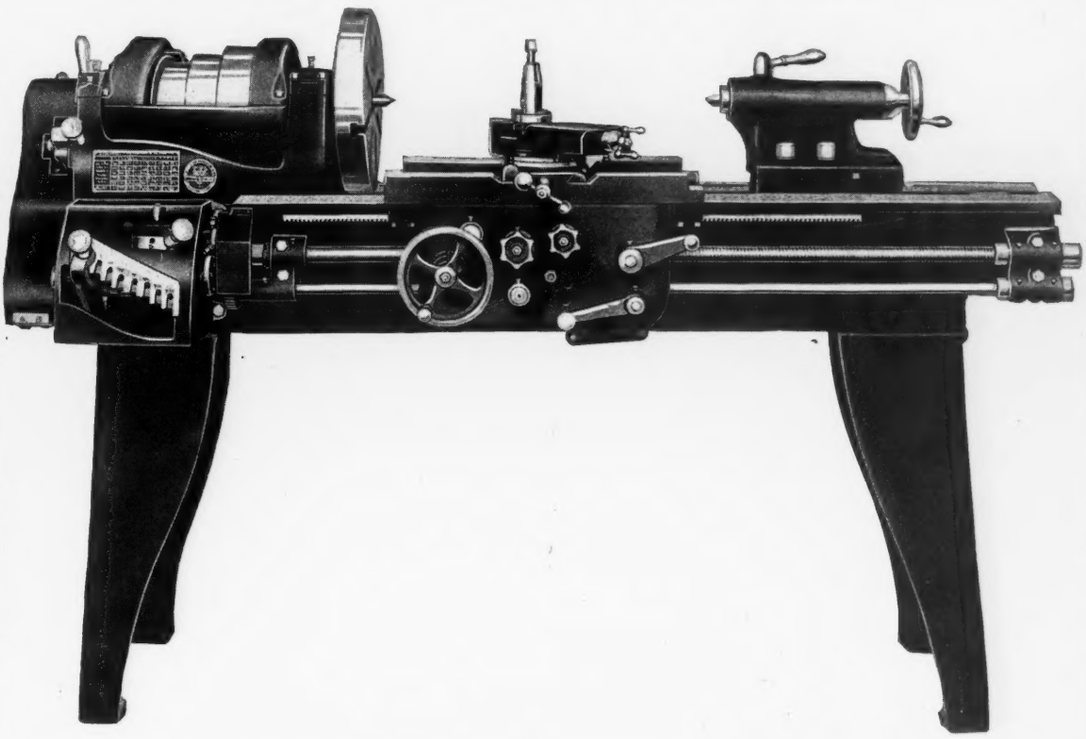


Three Step Cone, Double Back Gear, Double Plate Apron

THE BOYE & EMMES MACHINE TOOL CO.

CINCINNATI *ENGINE LATHES* OHIO

MONARCH



"Satisfaction to the Purchaser" is the policy of the Monarch organization. From the department for the purchase of raw material through the entire production department and into the sales organization this influence dominates.

It is clearly apparent in the final drastic inspection which every Monarch Lathe receives before receiving its final O. K. tag. The success of this policy is best demonstrated in the fact that a large percentage of the yearly sales go to present users. Each year the Monarch organization builds and sells more Monarch's than there are lathes produced by any other high grade lathe manufacturer.

DISTRIBUTORS:

Lynd Farquhar Co., Boston, Mass.
Brownell Machinery Co., Providence, R. I.
Purinton & Smith, Hartford, Conn.
Vandyck-Churchill Co., New York, N. Y.
Syracuse Supply Co., Syracuse, N. Y.
Syracuse Supply Co., Buffalo, N. Y.
Syracuse Supply Co., Rochester, N. Y.
Simmons Machine Co., Albany, N. Y.
Morris Machinery Co., Newark, N. J.
Monarch Machinery Co., Philadelphia, Pa.
J. S. Miller Machinery Co., Pittsburgh, Pa.
Randle Mchy. Co., Cincinnati, Ohio.
Greensboro Supply Co., Greensboro, N. C.
John P. Dale Machinery Co., Nashville, Tenn.
Oliver H. Van Horn Co., New Orleans, La.
Cameron & Barkley, Jacksonville, Fla., and Charleston, S. C.
The Walraven Co., Atlanta, Ga.
Hartfelder-Garbut Co., Savannah, Ga.
W. M. Pattison Supply Co., Cleveland, Ohio.
Coghlin-Kirkby Machinery & Supply Co., Toledo, Ohio.
Osborne & Sexton Machinery Co., Columbus, Ohio.
Vonnegut Machinery Co., Indianapolis, Ind.
Chas. A. Strelinger Co., Detroit, Mich.
McMullen Machinery Co., Grand Rapids, Mich.
Badger-Packard Machinery Co., Milwaukee, Wis.
Northern Machinery Co., Minneapolis, Minn.
Colcord-Wright Machinery & Supply Co., St. Louis, Mo.
English Tool & Supply Co., Kansas City, Mo.
Sunderland Machinery & Supply Co., Omaha, Neb.
Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo.
Salt Lake Hardware Co., Salt Lake City, Utah.
General Machinery Co., Spokane, Wash.
Hallidie Machinery Co., Seattle, Wash.
Portland Machinery Co., Portland, Oregon.
Herbert Machinery & Supply Co., San Francisco, Cal.
Herbert Machinery & Supply Co., Los Angeles, Cal.
E. L. Esaley Machinery Co., Chicago, Illinois.
V. Lowener, Denmark, Finland, Norway and Sweden.
Smith Courtenay Co., Richmond, Va.
Chas. A. Strelinger Co., Windsor, Ont., Canada.
William Blake Patterson, Special Representative, Switzerland and Italy.

THE MONARCH MACHINE TOOL CO.
SIDNEY, OHIO.

SEBASTIAN LATHES

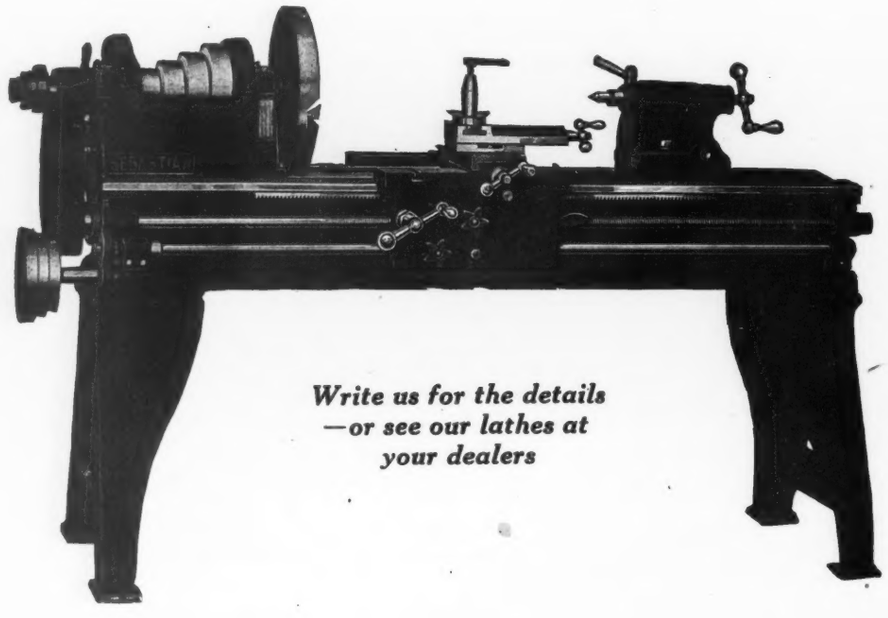
High Grade Standard Machines for Tool Room and Shop—

The Sebastian Cone Head Engine Lathe

A Good Lathe at a Fair Price—this is the standard to which each Sebastian Lathe is built—the reason for the universal satisfaction that is found in their use.

Carefully built, well balanced and well braced, with semi-enclosed construction for the head stock to increase the strength and lessen vibration; with operating conveniences and ample lubrication to insure easy operation, this Sebastian Cone Head Lathe is a good example of the Sebastian Line.

Made in 13″ and 15″ sizes and may be had with a gap bed 7¾″ long, 3½″ wide without extra charge.

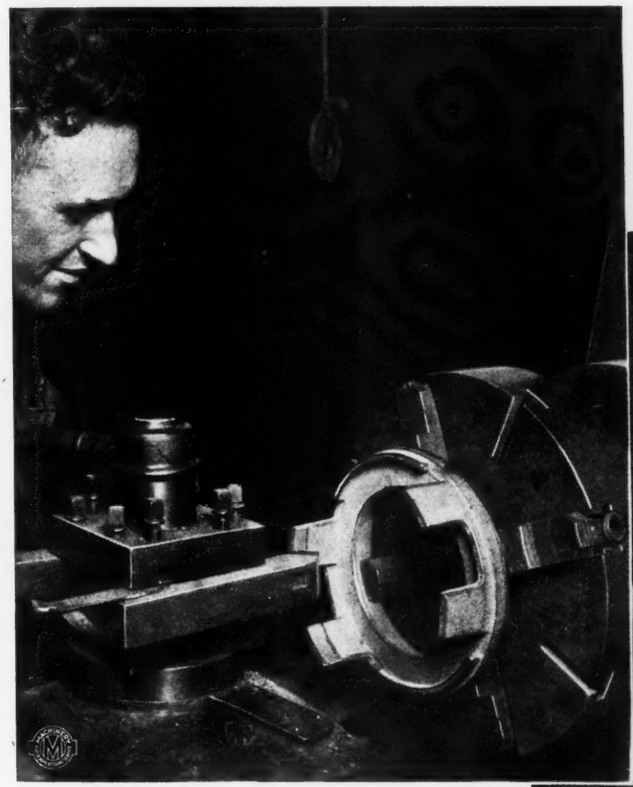


Write us for the details —or see our lathes at your dealers

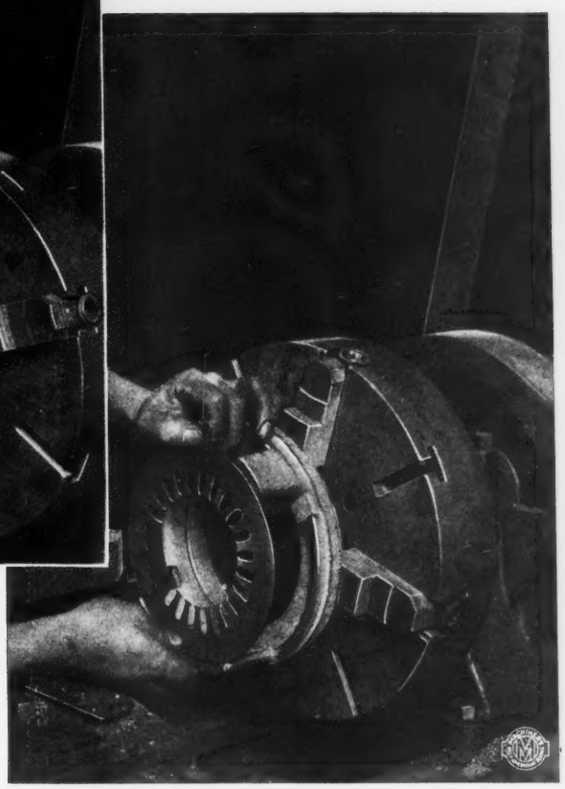
THE SEBASTIAN LATHE COMPANY
154 CULVERT STREET CINCINNATI, OHIO

"LEHMANN LATHES"

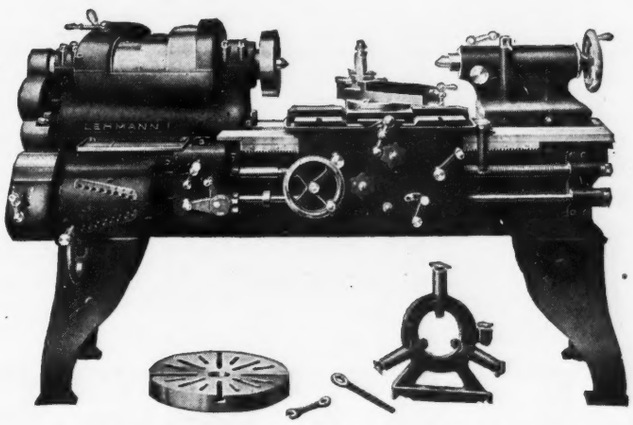
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"Lehmann Lathes" meet the needs of precision production, and are real time-savers. The photograph illustrates a "Lehmann Lathe" boring a stator ring for a "St. Louis" ½ H. P. polyphase motor. Two boring cuts are taken in addition to one internal facing cut. Production averages at the rate of six per hour despite the fact that the limits are plus or minus 0.001".



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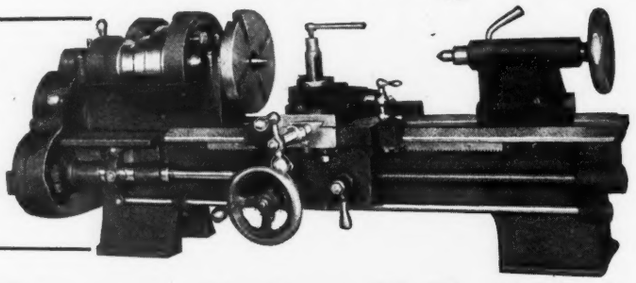
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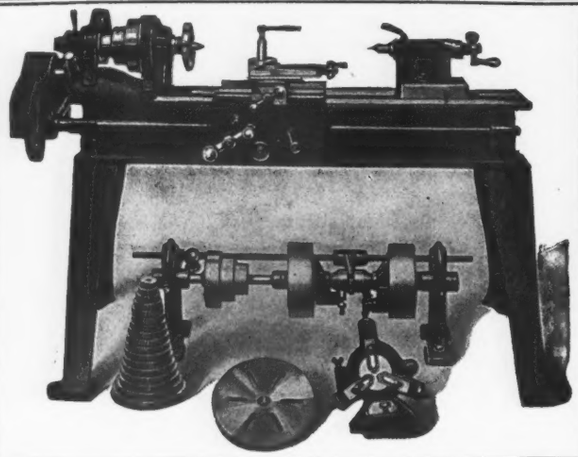
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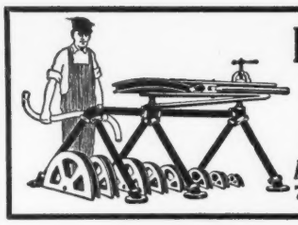


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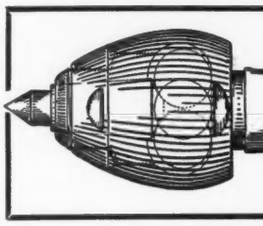
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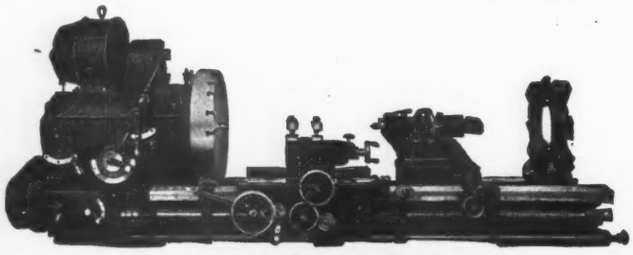
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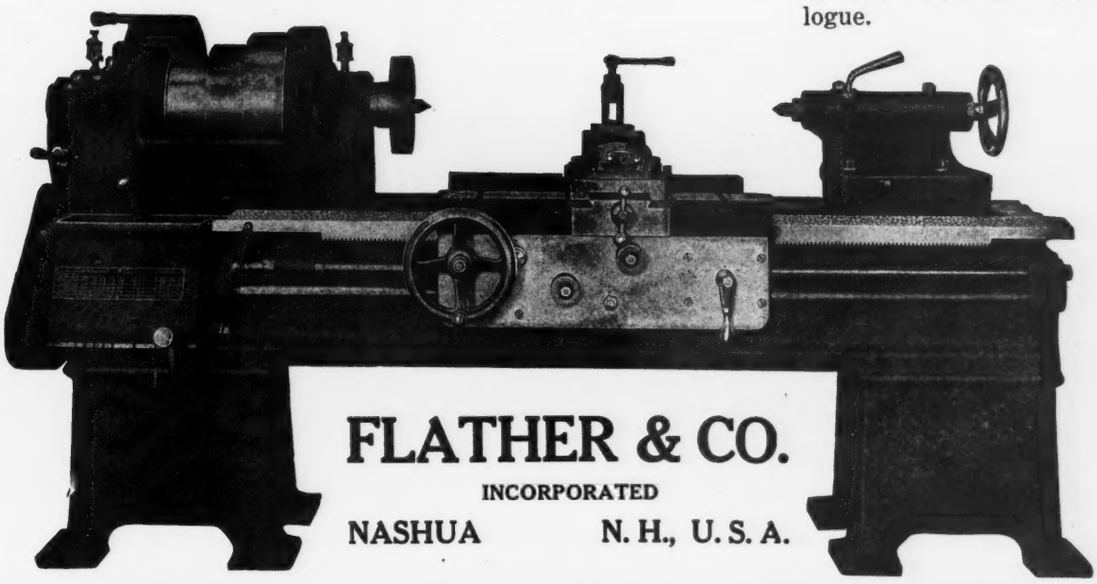
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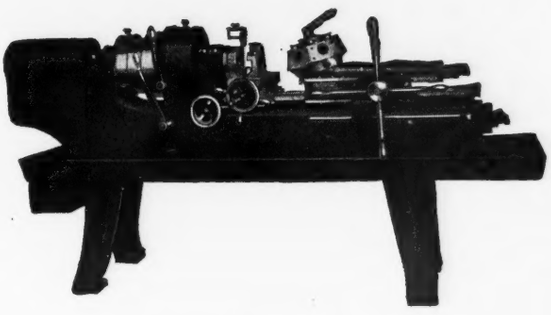
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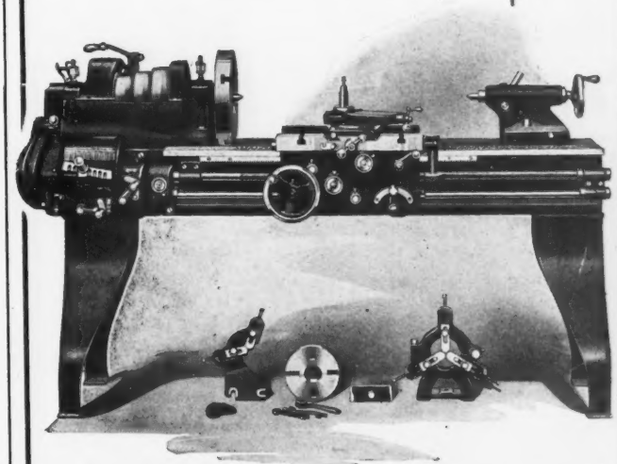
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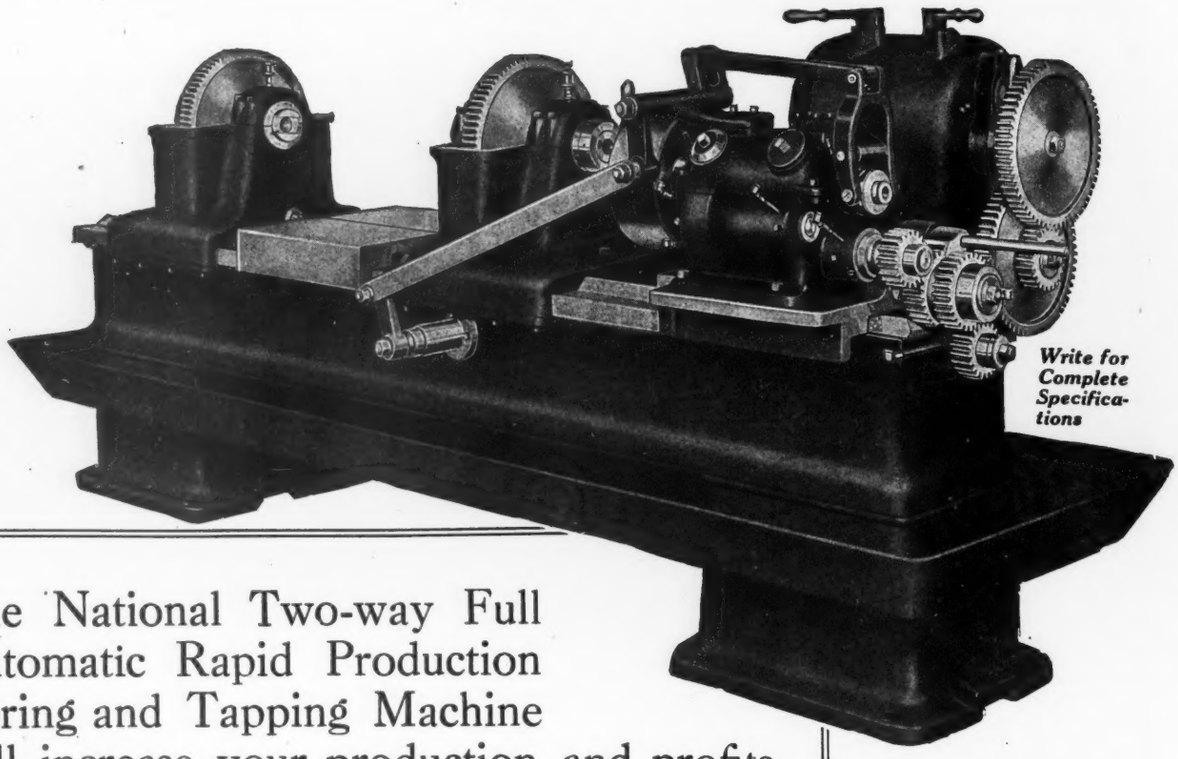
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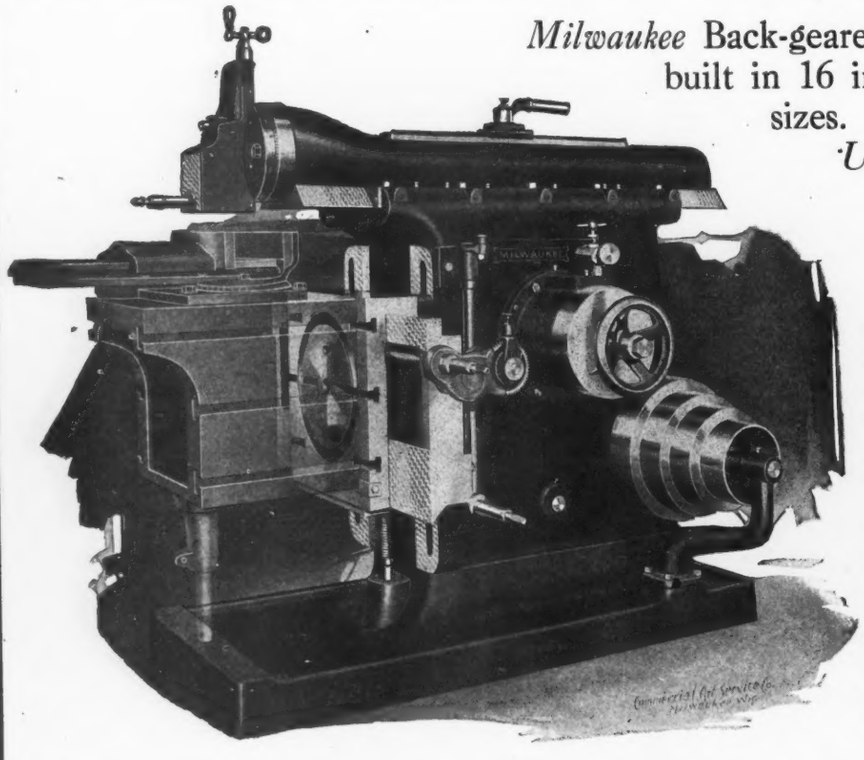


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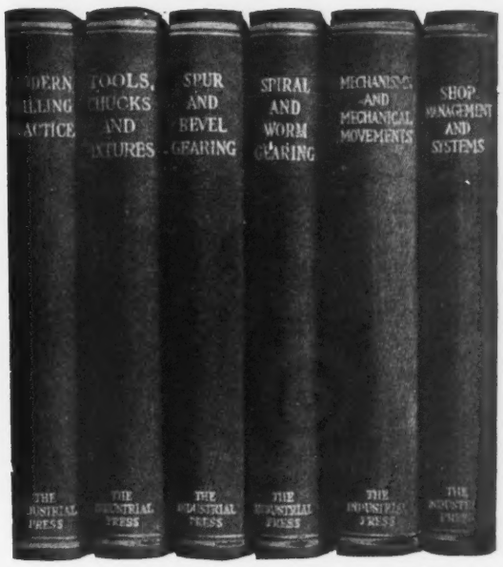
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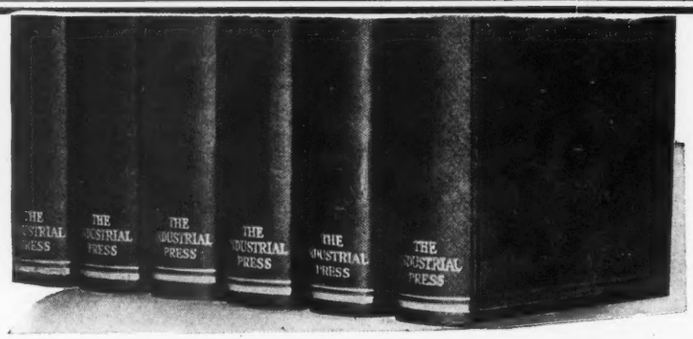
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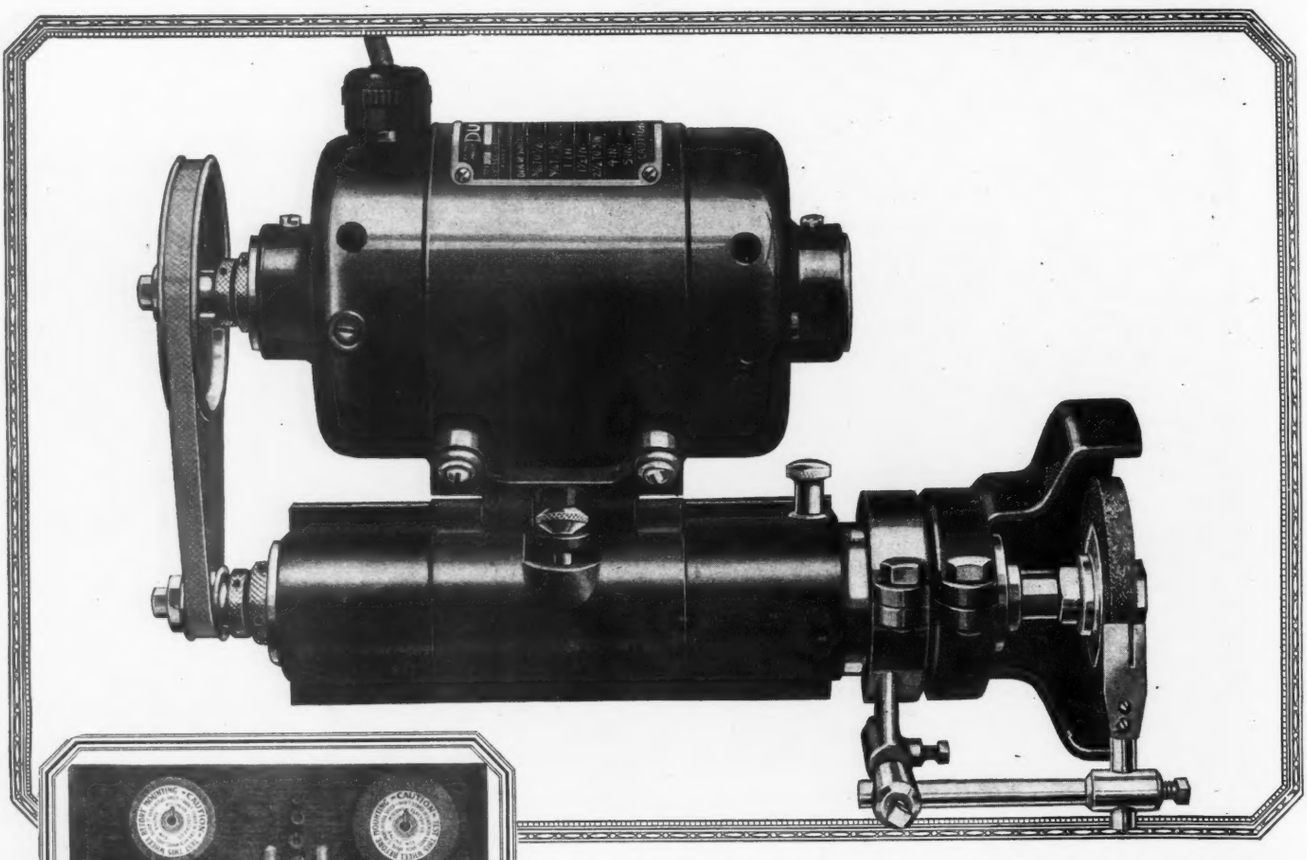
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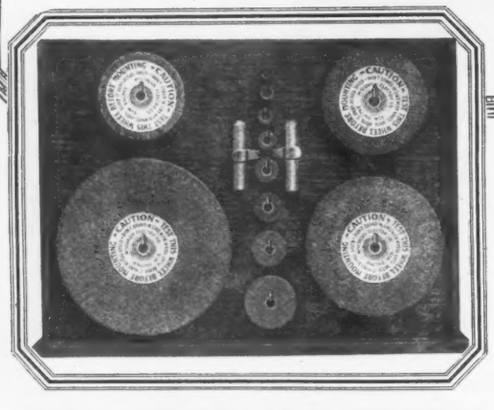
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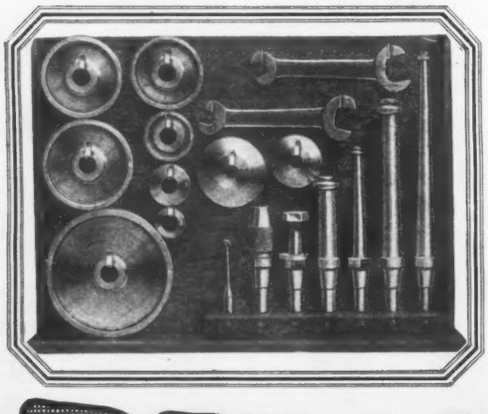
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Twelve elastic wheels are furnished.

Diameter	Diameter
5"	13/16"
4"	9/16"
3"	½"
2½"	7/16"
1½"	⅜"
1"	¼"

Two ⅜" round emery pencils.
Four extension spindles, as follows, for internal work:
One ⅝" x 2"—heavy duty.
One ⅝" x 4"—heavy duty.
One 7/16" x 3"—light duty.
One ⅝" x 6"—light duty.
One wheel arbor with two sets wheel collars for wheels from 2" to 5".
One wheel arbor equipped with special chuck for grinding button dies.
One extension spindle for above chuck.
One wheel guard and cutter grinding rest.
One cross feed lever. 10' reinforced portable cord.
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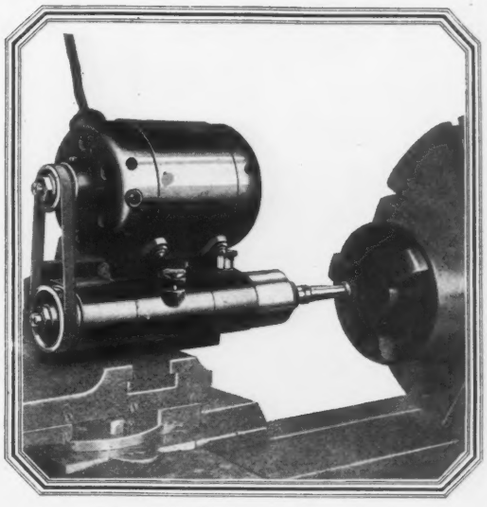
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DUMORE MULTI SPEED GRINDER

A Spindle and Speed for Every Need.

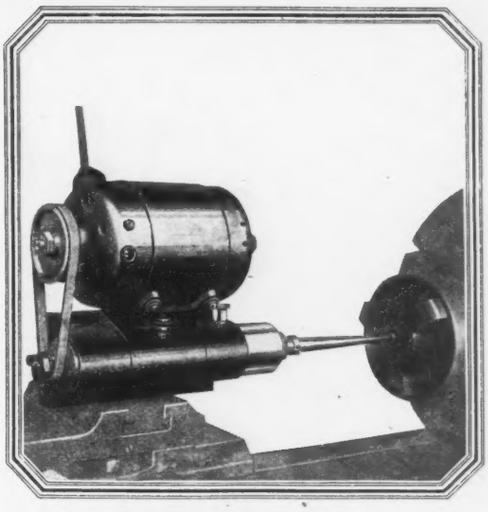
The Dumore No. 3 Grinder can be used on fine tool work and production work where close limits are essential.

The combination of spindles and quick change pulleys furnished as regular equipment with a Dumore No. 3 Grinder enables the mechanic to obtain exactly the right grinding speed for all jobs. Seven interchangeable spindles and pulleys give a speed range from 3600 to 50,000 R.P.M.



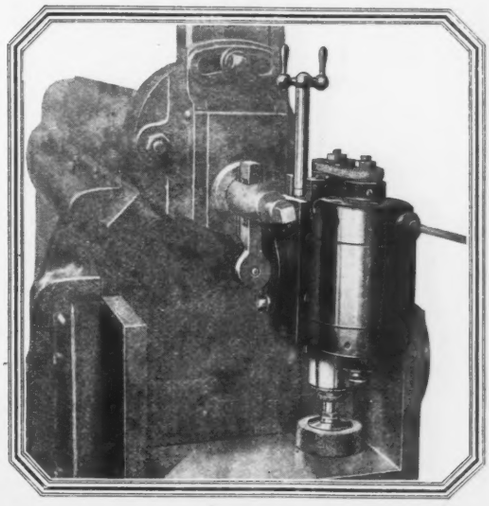
Motor Swivels to Five Positions

Set-ups are facilitated, time and trouble are saved by a special construction that enables the operator to swivel the motor to five different positions. This feature is of special importance on jobs where the surface to be ground is not easily accessible. By simply disengaging the index pin the motor may be swiveled so as to give easy access to even the most difficult grinding positions.



Grinder Reversible, End for End

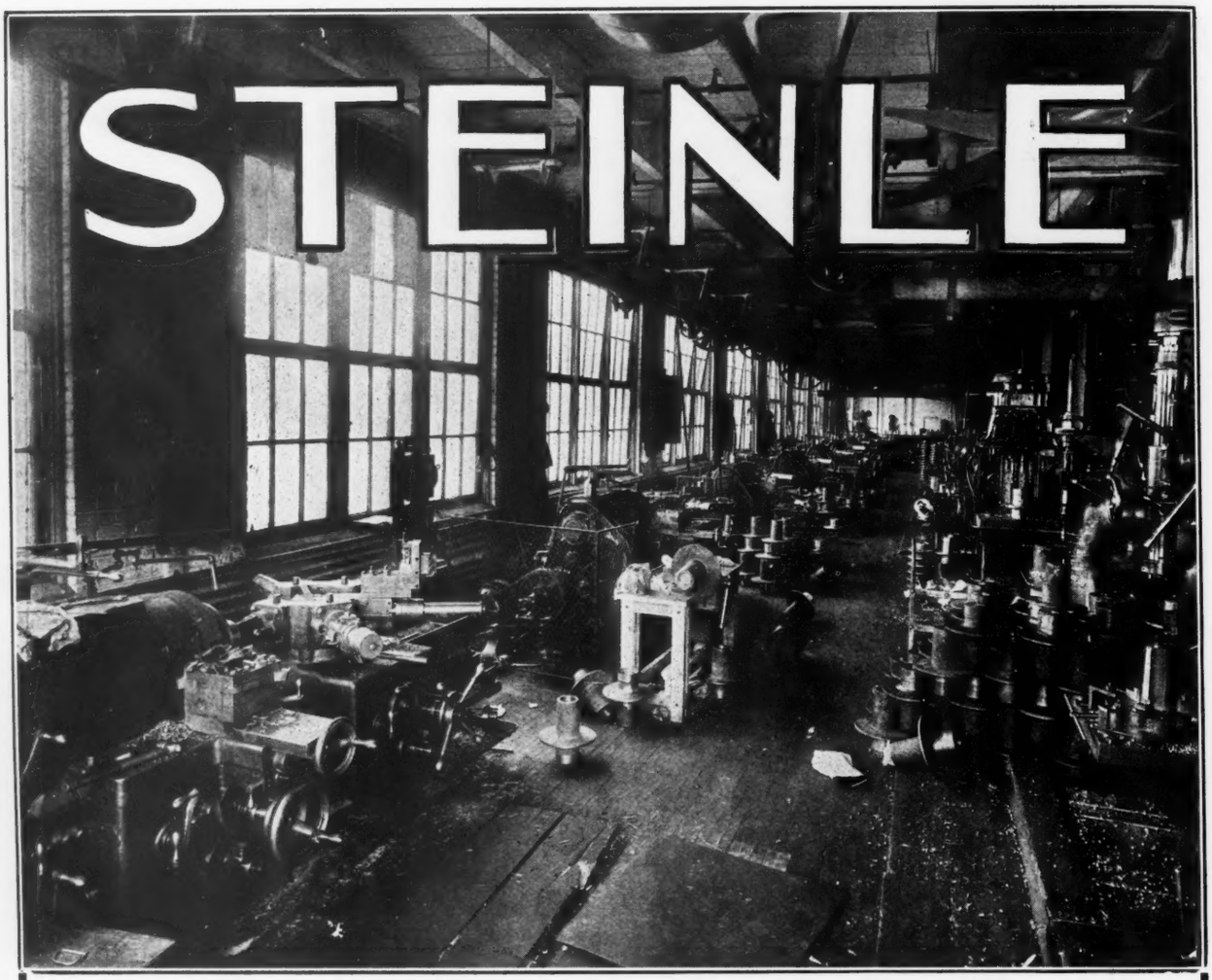
The shank, which is at the center of the slide, permits turning the Grinder end for end without raising or lowering the center of the grinding spindle. The Dumore No. 3 Grinder is so compact that it can be used on any size lathe down to and including an 8″ lathe. On the other hand its rigid construction permits the use of wheels 5″ in diameter.



For further information write us or ask your dealer for a demonstration

2526 16th Street, Racine, Wis.

MULTI SPEED GRINDER DUMORE



A Zone of Real Production

And not only is this true of the battery of Steinle Heavy Duty Full Swing Side Turret Lathes shown on hub work above, but it is also true of those numerous other batteries of machines engaged in the production of such other automobile, truck or tractor parts as fly wheels, brake housings, axle housings, differential cases, pistons, piston rings, gear blanks, and similar parts—each machine a master producer—each location a zone of real production.

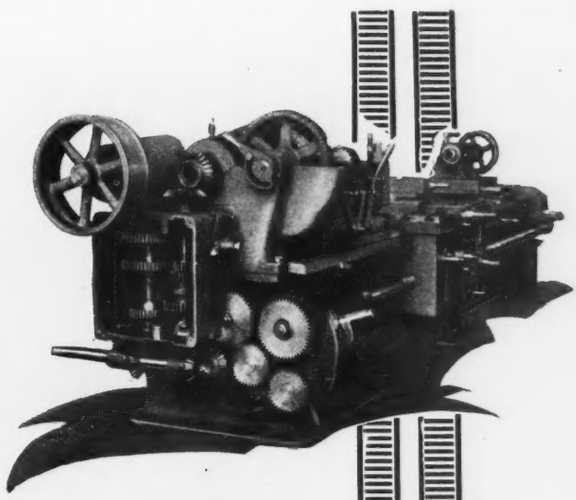
Why not send us your blue prints and let our Engineering Department determine what can be done on your own work.

AGENTS: Machine Tool Engineering Company, Singer Building, New York City; Cadillac Tool Company, Dodge Power Building, Detroit, Michigan; L. G. Henes, 75 Fremont Street, San Francisco, California, and Title Insurance Bldg., Los Angeles, California.

FOREIGN:. Leo. C. Steinle, 53 Victoria Street, London, Eng.

Steinle Turret Machine Co.

MADISON WISCONSIN, U. S. A.



You cannot escape these facts
They mean a better
Income for you

Most in production for the least amount of money—greater and more varied output from your plant without extra equipment. If you can achieve these things, then you are the man who is going to profit. You want

McCabe's "All-in-one" Lathe

If you ever believed that the maximum in lathe-building had been reached, one single look at this all-purpose-all-in-one McCabe will convince you that lathe-engineering has been outdone.

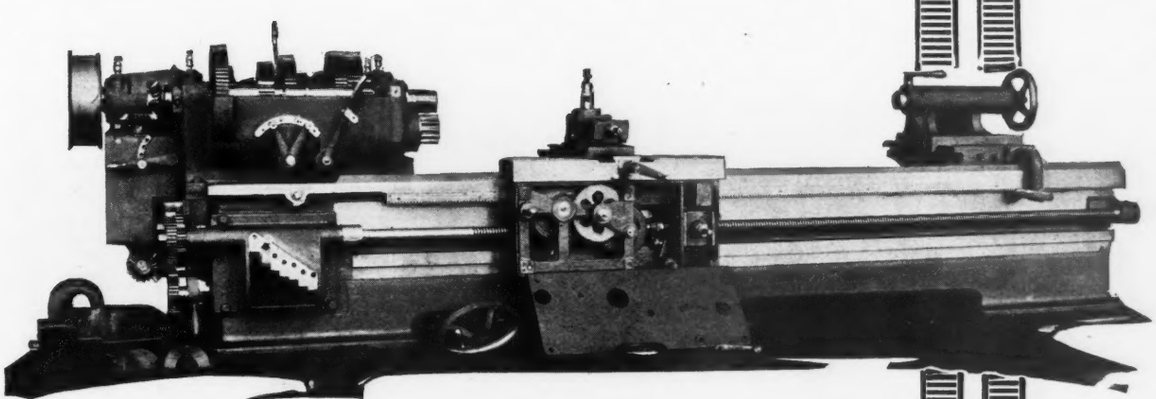
Unload responsibility on to the McCabe
Its shoulders are broader than yours

Here you have all the speeds, all the feeds, all the conveniences and advantages of all lathes, from 24″ to 40″. The McCabe carries all loads, all stresses. Great power with little effort—close accuracy with "unlimited" capacity, and with the same easy, simple and familiar controls you have been accustomed to. All this and more at a cost of two to three thousand dollars less than a group of machines, the range of which is no greater than this one McCabe.

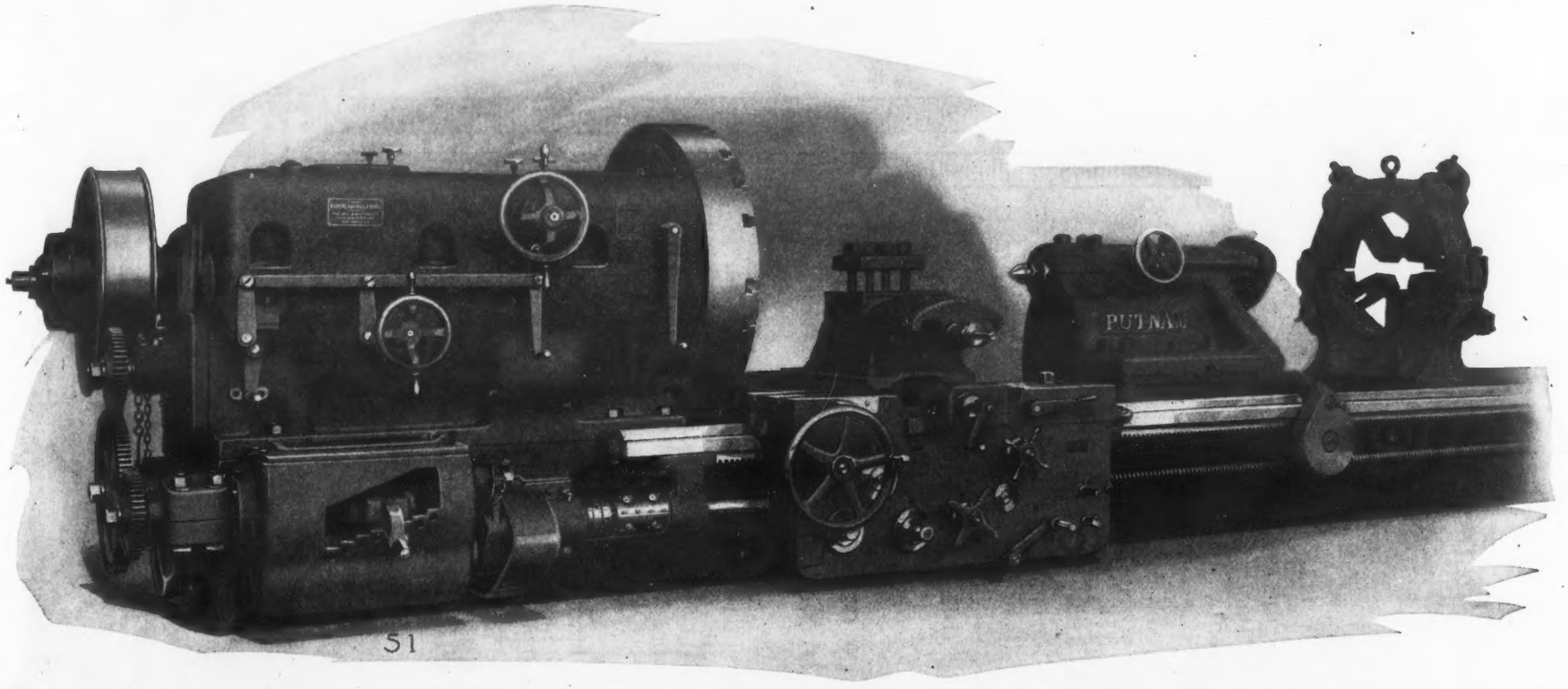
Tell your buyer you want this lathe, but don't specify McCabe simply because it is different, say you want a McCabe because it is better. All arguments are clinched with a McCabe demonstration.

J. J. McCabe Lathe & Machinery Corporation

149 Broadway **New York City**



Don't Buy Because IT'S DIFFERENT, But Because IT'S BETTER!



Putnam Machine Co. 60-in. Geared Head Lathe

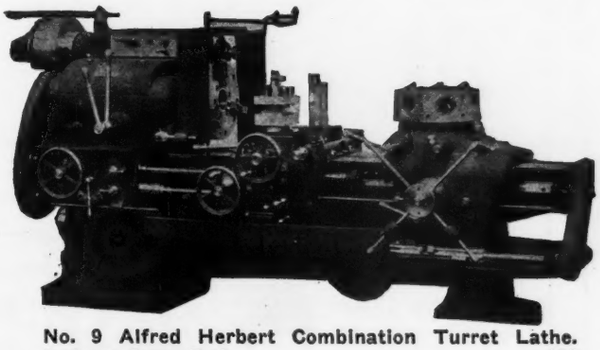
Also built in sizes 36-inch, 42-inch and 50-inch Swing

MANNING, MAXWELL & MOORE, Inc., 119 WEST FORTIETH ST. NEW YORK

BRANCHES: Chicago, Philadelphia, Boston, St. Louis, Pittsburgh, Cleveland, New Haven, Cincinnati, Buffalo, Detroit, Milwaukee, San Francisco, Seattle. Mexico City, Mexico. Yokohama, Japan.

PRODUCTION TURRET LATHES

STOCK DELIVERY



No. 9 Alfred Herbert Combination Turret Lathe.

Swings Over Bed	20"
Admits Through Spindle	3½"
Flange of Spindle to Face of Turret	48"
No. Spindle speeds Forward	16
No. Spindle speeds Reverse	16
No. Feeds to Turret Slide	18
No. Feeds to Carriage	9

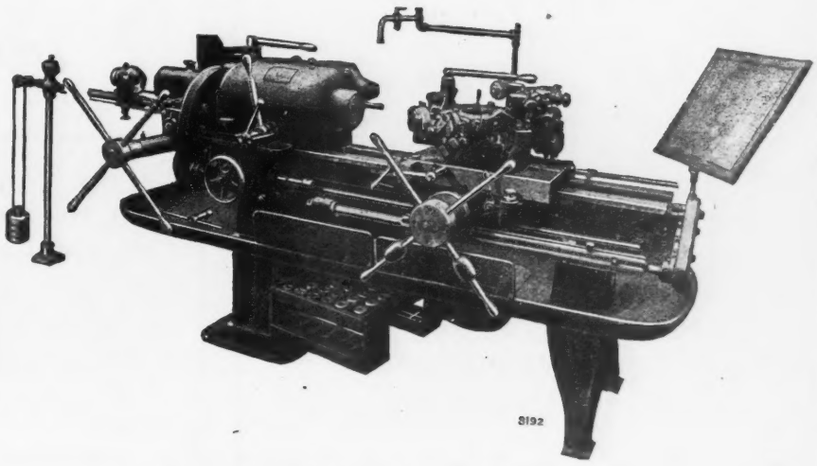
No. 9 Combination Turret Lathe

possesses not only the rigidity and power to remove metal at high speeds and coarse feeds, but also has and retains that exactness of alignment which enables it to take fine sizing cuts with consistent accuracy.

No. 1 Hexagon Turret Lathe

is built for bar work and constructed to permit large reductions at high speeds and feeds at one operation. It is especially adapted for quantity production where fine limits and high finish are desirable.

Bulletins No. 307-A and No. 309-A respectively contain full information and complete specifications of these machines.



No. 1 Alfred Herbert Hexagon Turret Lathe.

Largest Bar Admitted	1⅝"
Greatest Length Turned	27"
No. Spindle Speeds	8
No. Feeds	6

Production times will be furnished on receipt of dimensioned blueprints.

ALFRED HERBERT LTD.

54 Dey Street, New York **1-3 Jarvis Street, Toronto**

Head Office and Works: Coventry, England.
Other Branches and Associated Companies.

YOKOHAMA: 14 Yamashita-cho. OSAKA: 98, Sonesaki Kami. TOKIO: 13, Yamashita-cho, Kyobashiku. KOKURA: Osaki-Machi. Societe Anonyme Alfred Herbert, 47, Boulevard de Magenta, Paris; 39 Cours de la Liberte, Lyons; 178, Rue Barthelemy-Delespaul, Lille; 270, Calle de Mallorca, Barcelona. Societa Anonima Italiana Alfred Herbert, 42, Via Cajazzo, Milan. Alfred Herbert (India) Ltd., 13, British India Street, Calcutta; Standard Buildings, Hornby Road, Bombay. Societe Anonyme Belge Alfred Herbert, 35a and 35b, Rue de la Laeken, Brussels. C. E. Young, 57 George Street, North Circular Quay, Sydney.

Did You See The Cisco Motor Driven Geared Head 24-inch Lathe

at the Railway Master Mechanics' Convention, Atlantic City, in June, Spindle running one revolution in fifteen minutes at the welding exhibit of the General Electric Company?

Some lathe; some power. Very simply operated; very well designed; and with all its power, it is difficult to injure it. Repairs are few, if any.

We want you to know all about Cisco; the lathe with the pull, the lathe of simplified accuracy. Your neighbor has one and is well satisfied, and when he needs another lathe, he will buy a Cisco. Our catalogue gives you every particular and describes very thoroughly

The Best Lathe Built

THE CISCO MACHINE TOOL CO.

CINCINNATI OHIO, U. S. A.

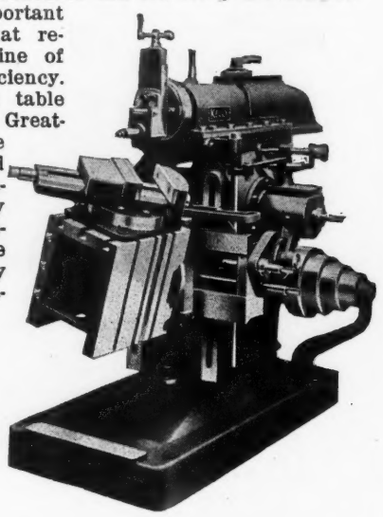
Makers of 14", 16", 18", 20", 24", 26" Engine and Tool Room Lathes, Cone Drive, Plain Motor Drive, Geared Head, Motor Driven Geared Head

A. R. Williams Mchy. Co., Ltd., Winnipeg, St. Johns, Toronto, Montreal and Vancouver, Can. Hendrie & Bolthoff Mfg. & Supply Co., Denver, Colo. Knight & Wall Co., Tampa, Fla. Westcoast Mchy. Co., Seattle, Wash. Cooperative Machinery Co., Cleveland, O. Harry Barney & C. W. Laughlin Mchy. Co., Pittsburgh, Pa. Manufacturers Selling Agency, Birmingham, Ala. C. E. Fales Mchy. Co., Detroit, Mich. Purinton & Smith, Hartford, Conn. F. H. Niles & Co., New York. Day Machinery Co., Buffalo, N. Y. The Morton Machinery Co., Philadelphia, Pa. Herbert R. Lowe, Providence, R. I. Dale-Brewster Mchy. Co., Inc., Chicago. Thompson Tool & Supply Co., Indianapolis, Ind. C. W. Frillman, Dayton, for Southern Ohio. Machineshop Equipment Corp'n., Boston, Mass. Crawford Mill Supply Co., Winston-Salem, N. C. Sullivan Hdw. Co., Anderson, S. C. Central Machine Tool Works, Ltd., London, England. Grimaldi & Co., Genoa, Italy. S. C. M. Reed Co., New York City for New Zealand, Tasmania, Java, Federated Malay States, India and Africa. R. L. Scrutton & Co., Sydney, N. S. W. Societe Internationale, M. D. M., Brussels, Belgium, for Belgium, France and Luxemburg. Alfred H. Schutte, Bilboa, Spain. Musee Du Commerce et de L'Industrie Internationaux, Paris, for the Balkans. Zayas Abreu Com. Co., Havana, Cuba.

Improved Kelly Shaper

None Better Regardless of Price

You can't buy greater accuracy, strength and durability than Kelly Crank Shapers provide no matter what you pay. Added to the old Kelly service formula are important new features that result in a machine of even greater efficiency. Note the tilting table and swivel vise. Greater convenience and increased range with capacity for heavy duty and fast production make the redesigned Kelly a popular machine.



ASK US ABOUT IT BEFORE YOU BUY SHAPERS

R. A. KELLY COMPANY

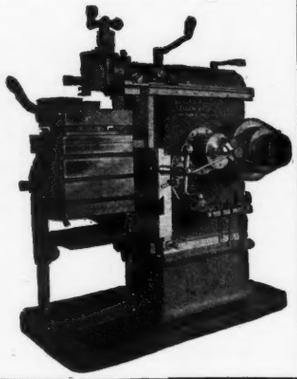
XENIA, OHIO, U. S. A.

Sellew Tool Room Crank Shapers

IDEAL FOR DIE WORK

Profitable for Manufacturing

Distinctive features include micrometer readings on all adjustments, Sellew Patented Outboard Table Support, universal adjustments of tables for planing compound angles, etc., and countershafts with two sets of tight and loose pulleys running in the same direction.



More Details?

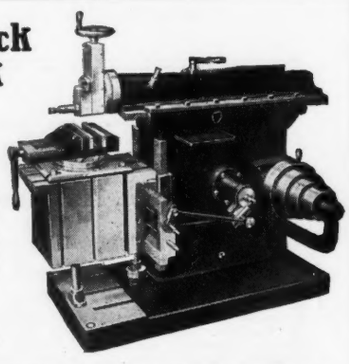
SELLEW MACHINE TOOL COMPANY

Pawtucket Rhode Island

Improved Back Geared Crank Shapers

Powerful, accurate machines, carefully proportioned with provision for ample adjustments easily and quickly made. Back gears run in oil. Eight speeds to ram.

Sizes 16", 20", 24".

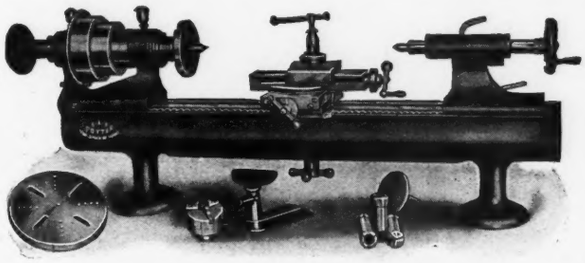


Send for our circular

THE OSBORNE & SEXTON MACHINERY CO.

COLUMBUS OHIO, U. S. A.

"POTTER PRECISION PAYS"—7" LATHE



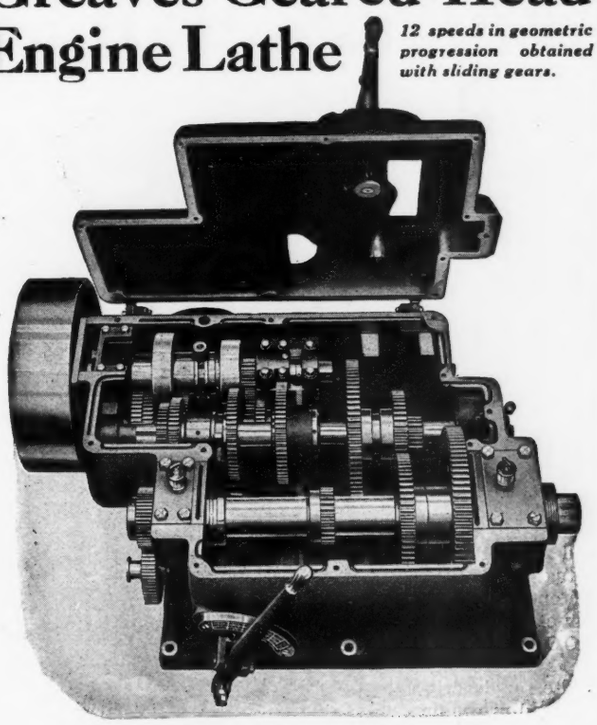
Catalog 9 for particulars

The Potter Precision Lathe is a fine job machine that works fast. Rigid construction, uniform accuracy and convenience for a wide range of operations through the use of suitable attachments are among its advantages. The machine is equipped with lever tail stock, double cross slide, large and small turrets, etc.; mills, cuts, threads, takes care of external and internal grinding; swings 7". It is both a tool room and manufacturing machine, economical and efficient in either service.

S. A. POTTER TOOL & MACHINE WORKS, 77 F. 130th St., New York City

Greaves Geared-Head Engine Lathe

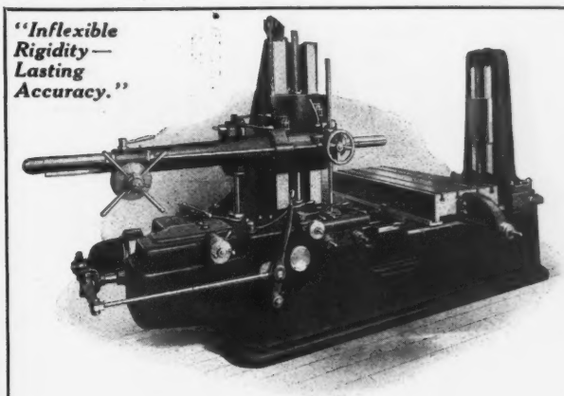
12 speeds in geometric progression obtained with sliding gears.



The cut shows the construction of the single pulley drive geared heads.

THE GREAVES MACHINE TOOL CO.
CINCINNATI OHIO, U. S. A.

"Inflexible Rigidity—Lasting Accuracy."



Blomquist-Eck Boring, Milling and Drilling Machines

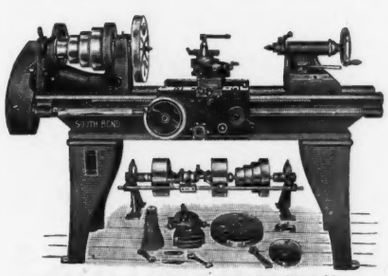
Wide range heavy duty machines with provisions for delicate adjustments that enable them to perform extremely accurate operations satisfactorily and economically. The details will interest you. Send for Circular.

The Blomquist-Eck Machine Co.
1146 E. 152nd Street Cleveland, Ohio

AGENTS: The Strong, Carlisle & Hammond Co., Cleveland, O., and Detroit, Mich. Dale-Brewster Machinery Co., Inc., Chicago, Ill. Badger-Packard Machinery Co., Milwaukee, Wis. Vandyck Churchill Company, New York City, N. Y. Ogden R. Adams, Rochester, N. Y. W. E. Shipley Machinery Co., Philadelphia, Pa. Brown & Zortman Mch. Co., Pittsburgh, Pa. Patterson Tool & Supply Co., Dayton, O. Fulton Supply Co., Atlanta, Ga. Savage & Winter Co., St. Paul and Minneapolis, Minn. Herberts Machinery & Supply Co., Los Angeles and San Francisco, Cal.
FOREIGN AGENTS: Gaston, Williams & Wigmore, Inc., France, Italy, Belgium, and Japan. Nielsen & Winther, Ltd., Norway, Sweden and Denmark. Buck & Hickman, United Kingdom of Great Britain. Garlock-Walker Machinery Co., Toronto, Canada. Andersen, Meyer & Co., Ltd., China.

SOUTH BEND LATHES

FOR THE MACHINE AND REPAIR SHOPS



16" x 6' LATHE, PRICE $550.00

13" Lathe.....	$385.00	18" Lathe.....	$735.00
15" Lathe.....	483.00	21" Lathe.....	900.00
16" Lathe.....	550.00	24" Lathe.....	1250.00

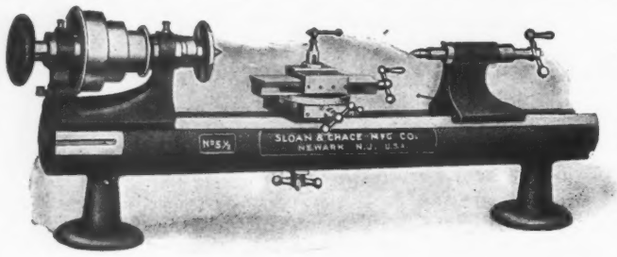
Price includes equipment as shown in illustration.
Made with straight or gap bed.

South Bend Lathes have been on the market fourteen years.

Free catalog mailed on request.
New York Office: 2½ Murray Street
Boston Office: 65 Oliver Street
Philadelphia Office: 33 N. Seventh Street

SOUTH BEND LATHE WORKS Established 1906 **420 Madison St., South Bend, Ind.**

SLOAN & CHACE No. 5½ BENCH LATHE



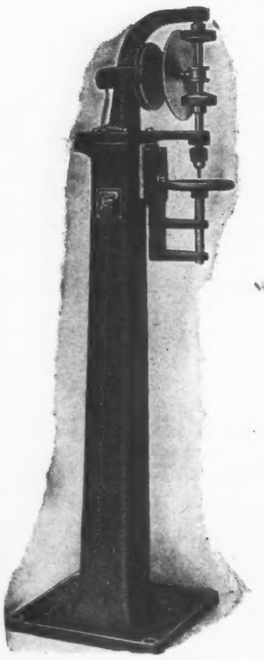
Accurate, generous proportions (7″ swing, 18″ between centers) enable it to handle a wide range of work.

Manufacturers of Precision Machinery, Bench Lathes, Drill Presses, Milling Machines, Gear and Pinion Cutters, Tools, Fixtures and Gauges.

Send for the Catalog listing all our machines

See our Exhibit at the International Machinery Exposition, Grand Central Palace, New York

SLOAN & CHACE MFG. CO., Ltd. 6th Ave., and N. 13th St., Newark, N. J.



Fenn Smooth-Running Tappers

Provided with sensitive friction drive which gives high speed for reverse—and more work with fewer taps. Fenn Tappers are strong, rapid, accurate machines, adapted for all classes of work up to 3/16″ diameter, economical to operate, easy on taps, durable, dependable—machines you'll like for their clean cut work.

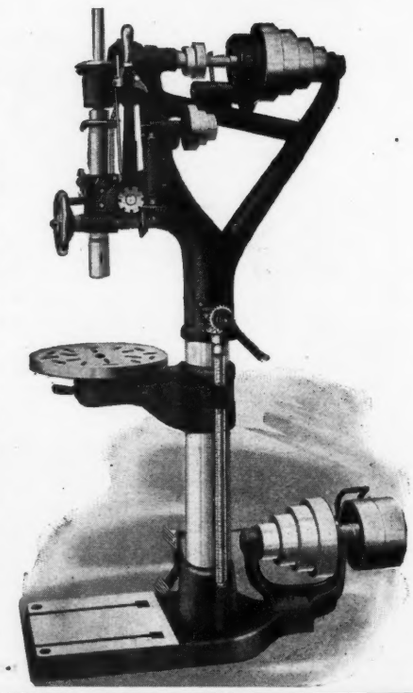
Details on request.

THE FENN MANUFACTURING CO.

HARTFORD CONN., U. S. A.

Cable Address "Fenn"—Western Union Code

HOOSIER DRILLS AND VISES

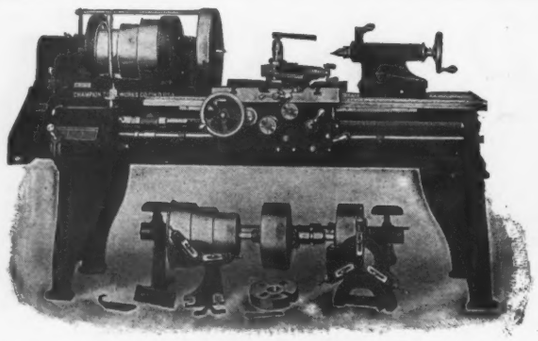


HOOSIER Drills are high class production machines. They are fast, accurate and have ample power. The large range of feeds and speeds adapts them to a great variety of operations. Square tables with oil rim can be furnished on all 16″ and 20″ drills. An actual test in your factory will prove our claims for the HOOSIER line.

Write for description and prices on drills and vises.

HOOSIER DRILLING MACHINE CO.

GOSHEN Dept. A. IND.



Sizes: 12", 14", 16", 18"

Write us for Catalog

CHAMPION

A Lathe for Today's Work

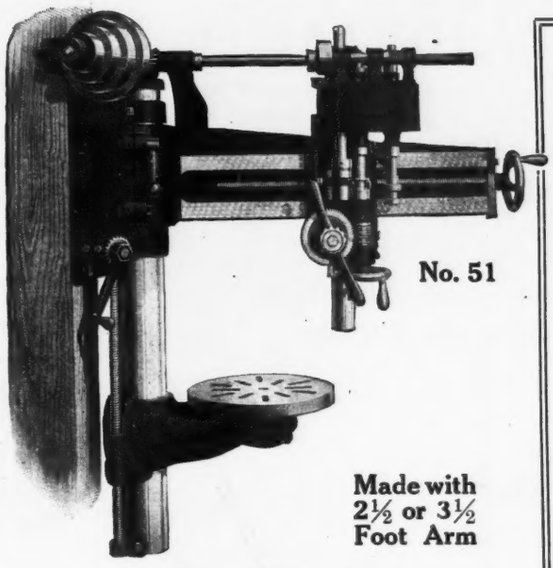
The quick change gears, the automatic stop in either direction, the friction cross and length feeds and the ability to drive high-speed cutting tools to their limit are the reasons why the "Champion" is a lathe for today's work, when greater production is necessary to the very life of the nation.

CHAMPION TOOL WORKS

4955 Spring Grove Ave. Cincinnati, Ohio

THE CANEDY-OTTO WALL TYPE RADIAL

A Machine Every Shop Needs



No. 51

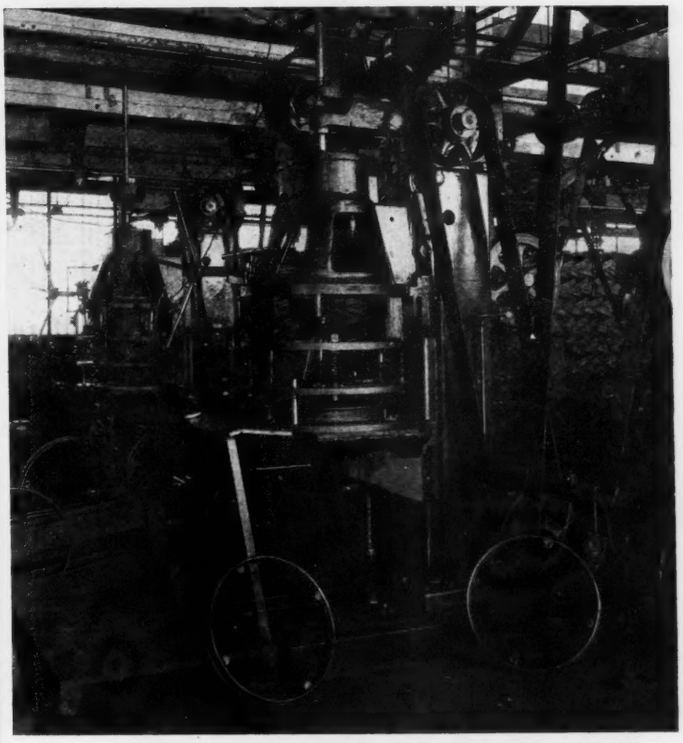
Made with 2½ or 3½ Foot Arm

Details and Prices on Request

Big shops need this practical and convenient machine to handle the odd jobs—small shops, garages, boiler works and repair shops use it for practically all drilling and tapping. It is low in price, takes little space and combines all the advantages of stationary drills up to 30″ and floor type radials of equal capacity. Self-feed, automatic cut-off, quick return lever and other convenient features are the same as in our more expensive heavy duty floor type machines.

Carried in Stock by Leading Jobbers and Machinery Dealers Everywhere

CANEDY-OTTO MFG. CO., Chicago Heights, Ill.



PRODUCTION WITH ECONOMY — SPEED WITH ACCURACY

Drilling 700 Holes An Hour!

Here illustrated are the Fox Multiple Spindle Drills at Jaxon Steel Products Company, Jackson, Michigan, each machine drilling rims at the rate of 175 per hour, each rim having four 19/32″ holes drilled in steel lugs ¼″ thick. These rims are used by General Motors Company and Ford Motor Co.

Have You a Drill That Can Do It?

"VARIABLE SPEEDS FOR DIFFERENT DIAMETERS"—ALWAYS AVAILABLE

Investigate "Fox Efficiency"—Write Today!

FOX MACHINE COMPANY

1812 W. Ganson Street
JACKSON, MICHIGAN

Formerly of Grand Rapids, Michigan

New York Office: Grand Central Palace

DOMESTIC AGENTS: Motch & Merryweather Mchy. Co., Cleveland; Somers, Fitler & Todd Co., Pittsburgh; Vonnegut Mchy. Co., Indianapolis; Badger-Packard Mchy. Co., Milwaukee. FOREIGN AGENTS: Selson Engineering Co., for England—New York City, 24 Stone Street.

HERCULES
POWER PRESS BROACH

"Two In One"

Think of it! A COMBINATION POWER ARBOR PRESS AND BROACHING MACHINE which has proven one of the best all around tools on the market today.

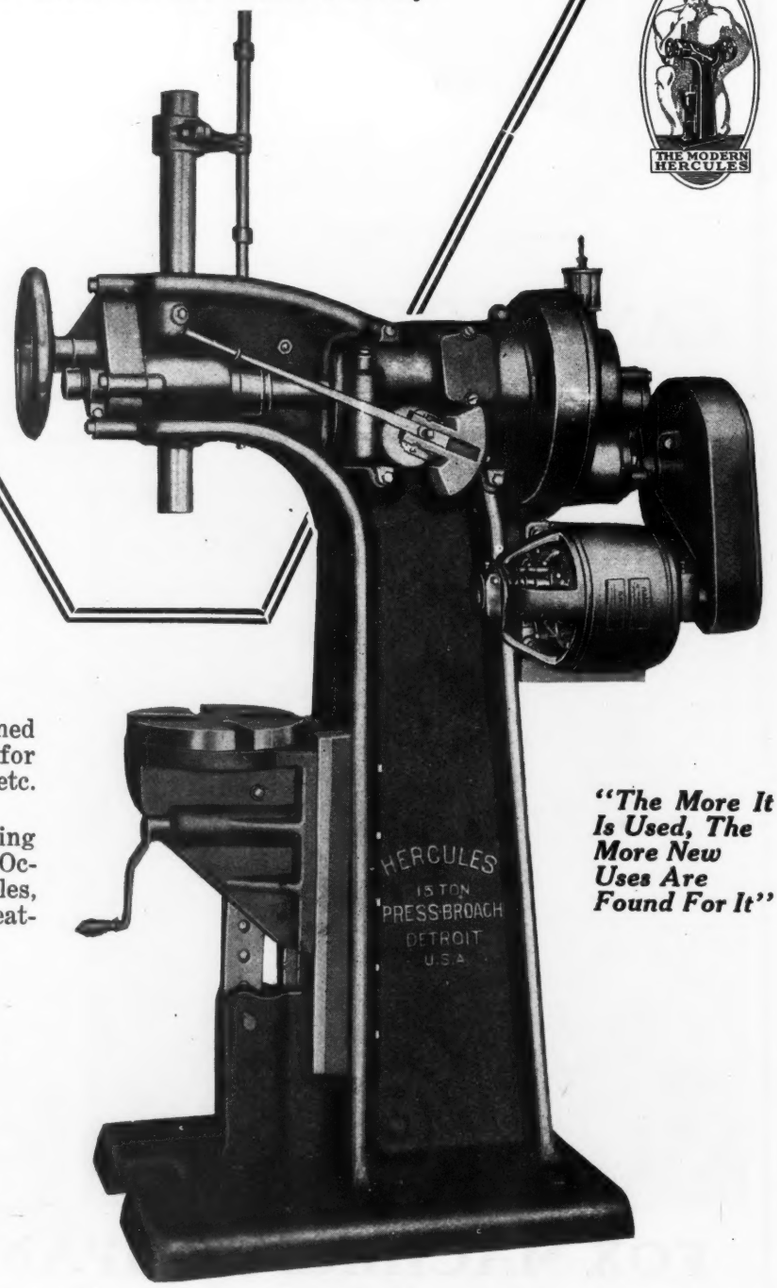


What It Does

Exceedingly Simple, Sturdy, Powerful and Convenient. Does with Exceptional Rapidity, and by Power, a large variety of operations requiring pressure, such as forcing arbors (mandrels) bushings, shafts or pins in or out of holes, seats into valves, linings into pumps, etc., straightening or bending, forming, sizing holes with hardened plugs, testing castings, sealing valves for testing, expanding babbitt bearings, etc.

An extremely efficient tool for Broaching any shaped hole, Square, Hexagon, Octagon or Oval. Four and Six Spline holes, also teeth on Gears and Racks, Key Seating, etc., etc.

Can you afford to be without it?



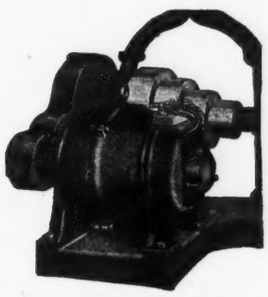
"The More It Is Used, The More New Uses Are Found For It"

HERCULES
MACHINERY CO.

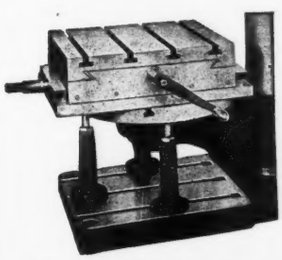
110 Woodbridge St.
DETROIT MICHIGAN

THE MECHANICS' DRILL

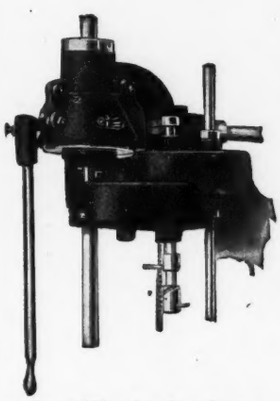
Just a Few of Their Important Points



Motor Drive Through Gears Direct to Lower Cone Shaft



Compound Table, Two Sizes 12" x 12" and 18" x 20"

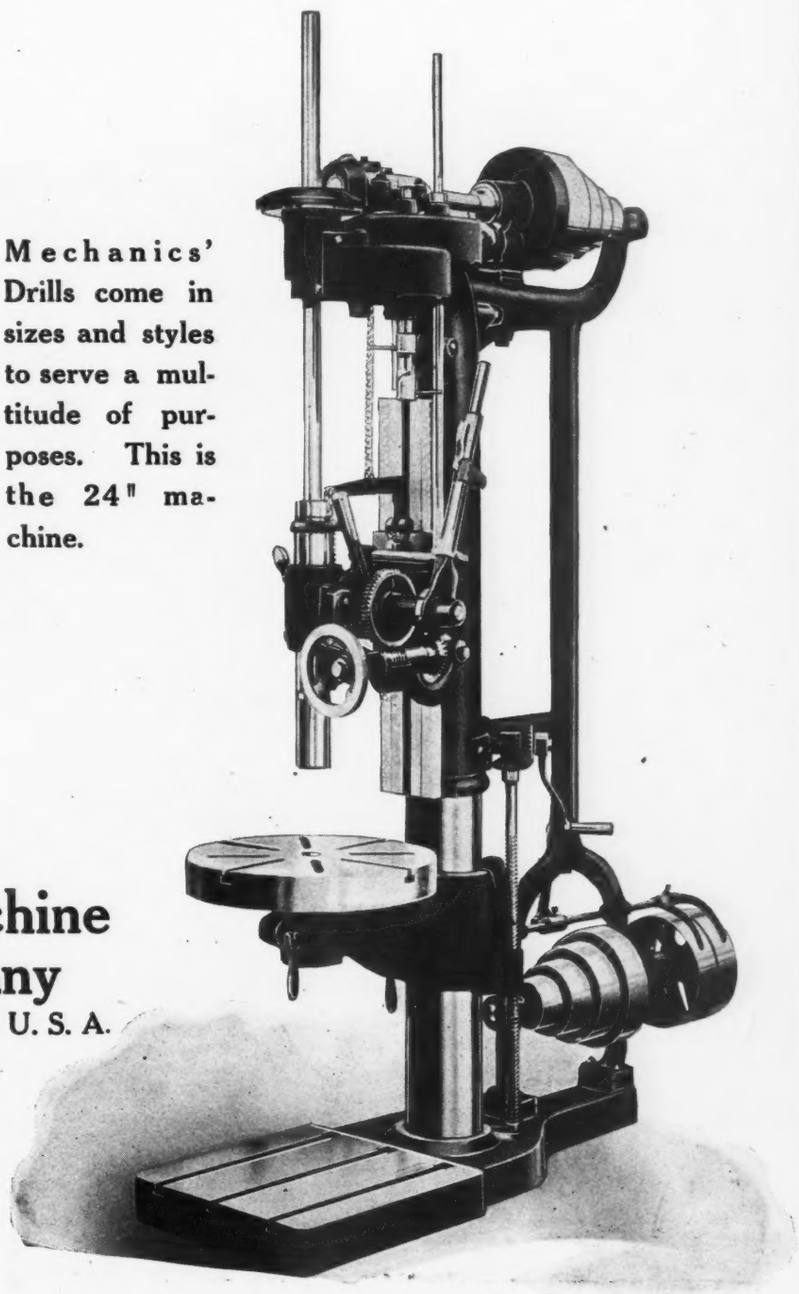


Geared Tapping Attachment

The exceptional scope, efficiency and power of Mechanics' Drills are characteristics best appreciated by their many users. Among the many points which call for particular notice are the drive, through four-step cone pulleys, improved enclosed back gear, and a correctly cut crown gear and pinion. Stationary head with takeup for wear on spindle sleeve is another useful feature. Eight-speed spindle has quick advance and return. Positive feeds are instantly available while machine is running.

A powerful and compact tapping attachment operates through positive steel clutches with quick return.

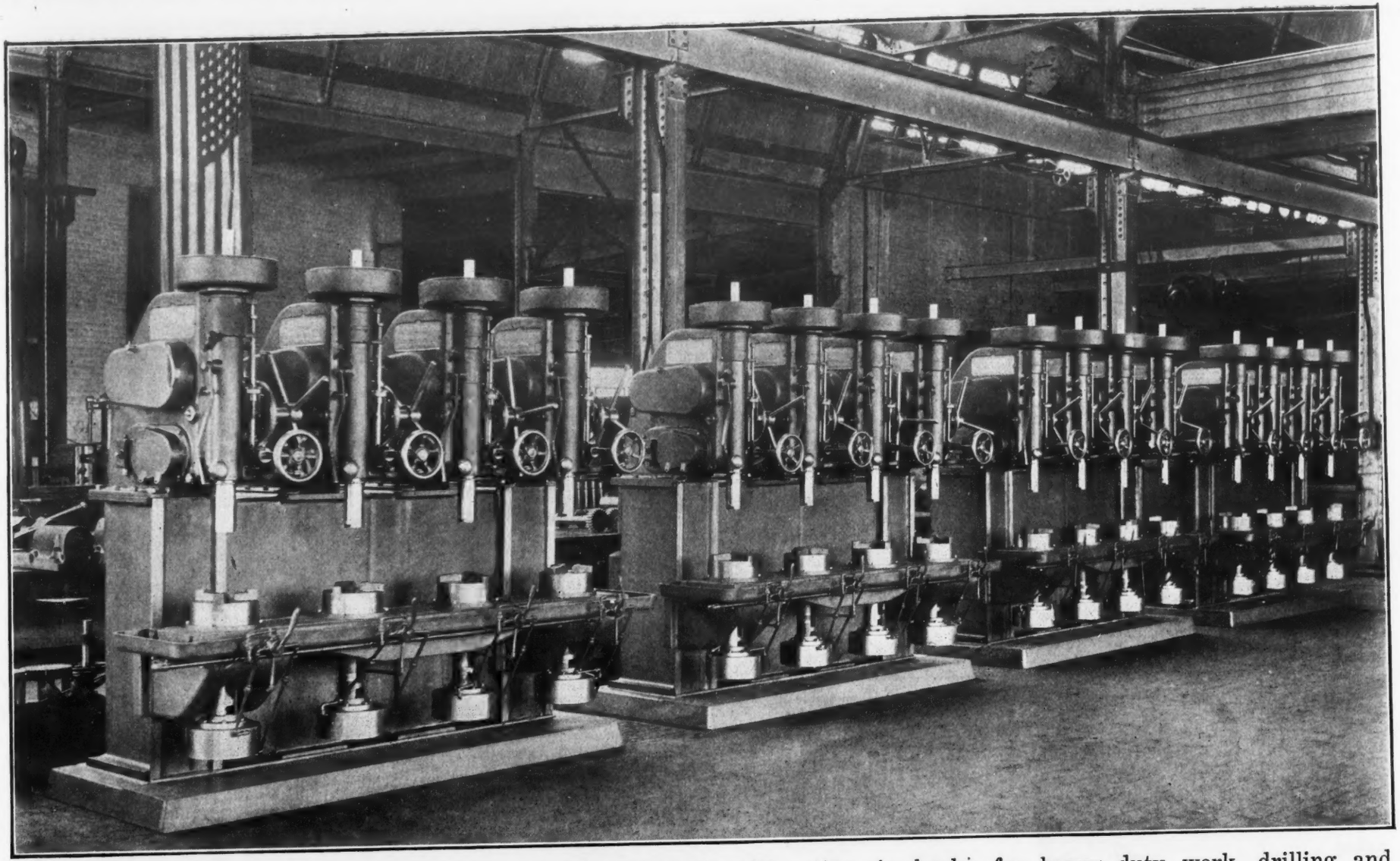
Mechanics' Drills come in sizes and styles to serve a multitude of purposes. This is the 24" machine.



Rockford Machine Tool Company

ROCKFORD ILL., U. S. A.

Ask for Booklet describing the full line.



BAKER DRILLS

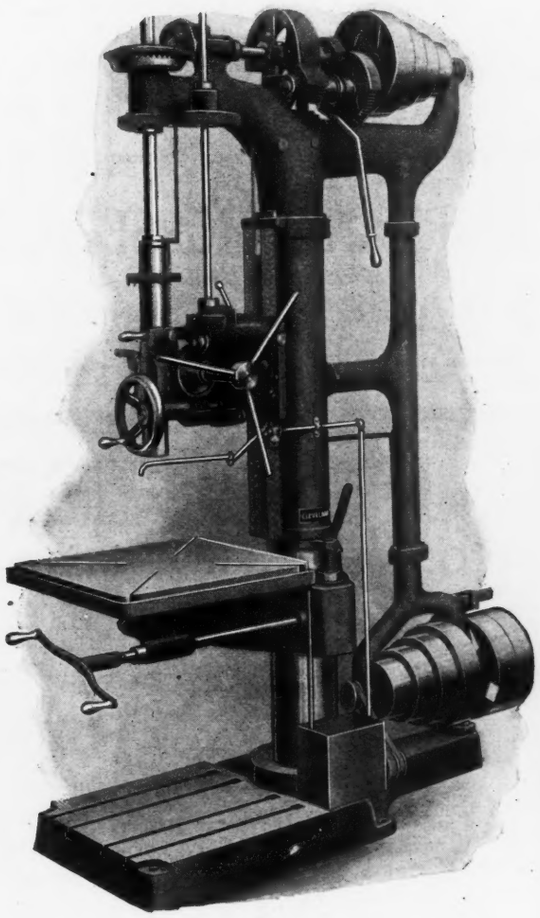
Equipped with quick acting air chucks for heavy duty work, drilling and reaming taper holes in drop forgings. (Part of one order from customer who already has over fifty machines).

If You Want PRODUCTION, ACCURACY and SERVICE Be Sure "IT'S A BAKER"

BAKER BROTHERS, Toledo, Ohio.

KERN DRILLING MACHINES

This 32" Machine Drills and Taps Holes up to 2½" Diameter in Solid Steel



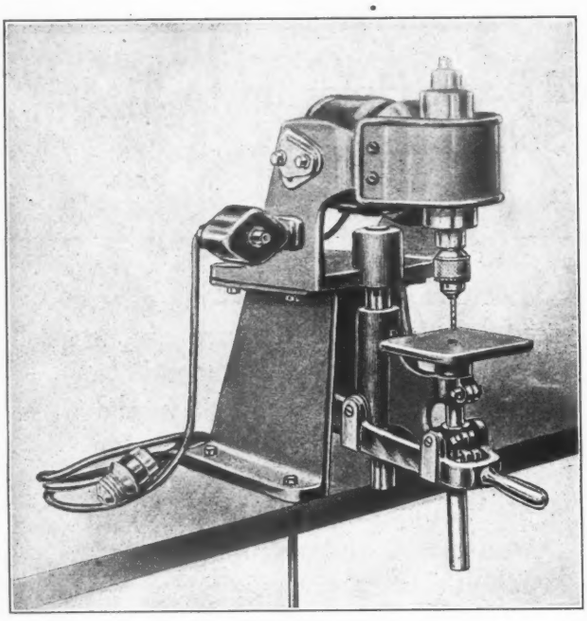
Positive geared feed, back gears and automatic stop are among the features that recommend this wide range, conveniently controlled upright drilling machine. Column is unusually large and well supported, and the head well gibbed and counterbalanced. Spindle is of special hammered steel with long bearing on sleeve, has a 10½" traverse and is equipped with quick return. Gears in the feed box on the sliding head are of steel—bronze bushed—and provide eight changes, from .006" to .048". Cone pulleys are 3" wide and drive pulleys 13" x 3½"—the speed of the lower shaft being 350 R.P.M.

This is a first-class machine—a machine with a well-established reputation as a profitable producer and the endorsement of master mechanics in many leading shops.

Complete description on request.

BUCKEYE DRILL & LATHE COMPANY
COLUMBUS **OHIO, U. S. A.**

Let Us Have Your Tapping Problem



"ANDERSON"

Spherical Friction Disc permitting variable tapping and reverse speeds.

Geared Heads for tapping more than *one hole* at a time attached to spindle.

Dial Feeds, either plain or automatic, attached to table.

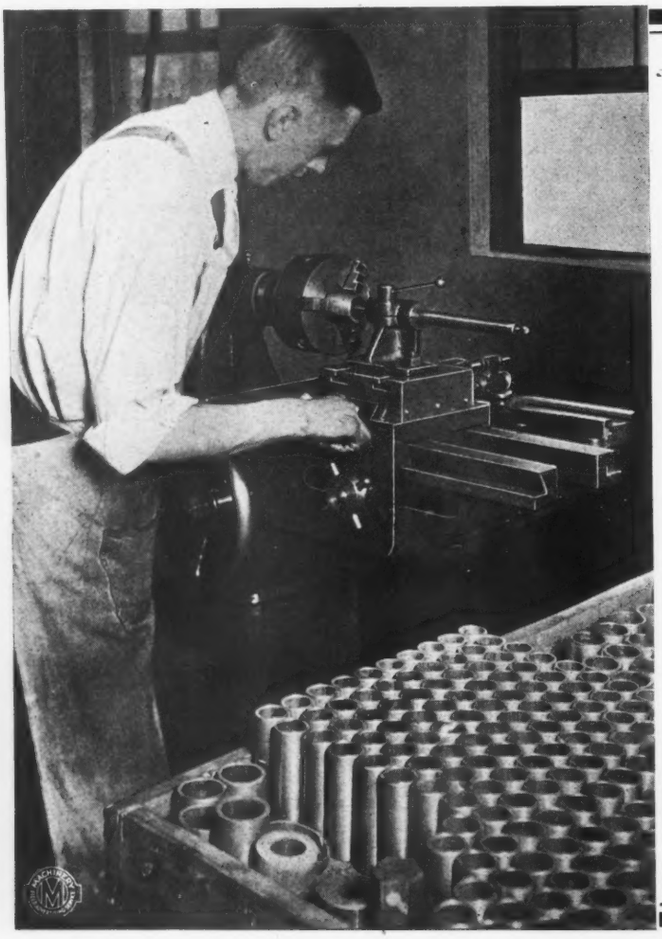
DIRECT MOTOR DRIVE
BENCH OR PEDESTAL

Send Sample or Print with complete information

FAIRBANKS-MORSE & CO.

Machine Tool Department

30 Church St. **New York City**



FISCHER

Oil Grooving Machine



First Choice Here—and It Made Good

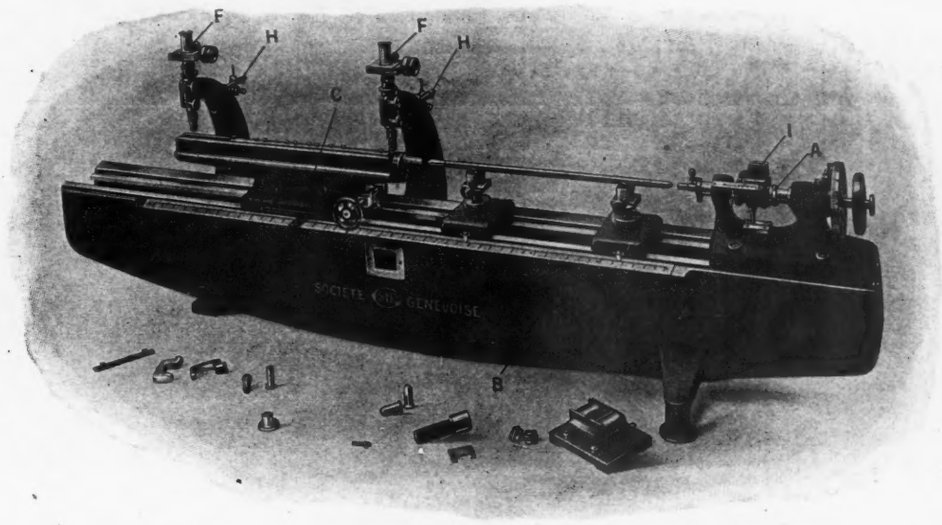
When the Buffalo Non-Ferrous Casting Co. (Buffalo, N. Y.,) started to manufacture bronze bushings, a Fischer Oil Grooving machine was one of the first pieces of equipment they bought. This machine—installed just two months when the photograph was taken—has been used for cutting all styles of oil grooves in bushings of various sizes to the unvarying satisfaction of the user.

Ask for details of this machine.

FISCHER MACHINE CO.

PHILADELPHIA **PA., U. S. A.**

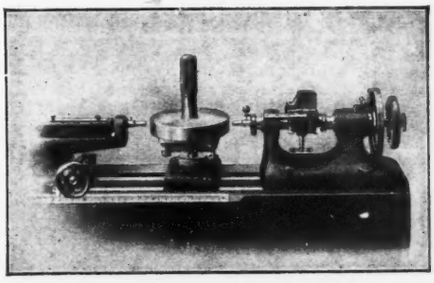
DOMESTIC AGENTS: Chas. A. Strelinger Co., Detroit, Mich. FOREIGN AGENTS: Coats Machine Tool Co., Ltd., 14 Palmer St., Westminster, London, Glasgow and Newcastle-on-Tyne. Aux Forges de Vulcain, Paris, France. Yamataka & Co., Tokyo, Japan. Henry Coe & Clerici, Milan, Italy. Allied Mchy. Co., Spain, Portugal and Switzerland. Ateliers Demoor, Belgium. Chr. A. Herstad, Norway, Sweden, Denmark and Finland.



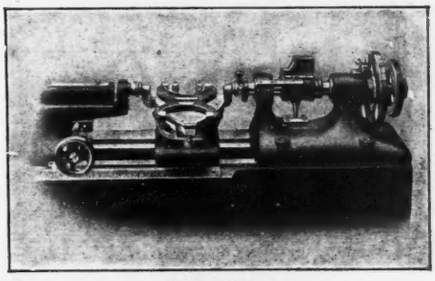
You Can Make Absolute Measurements Accurate to *.000005 inch* with the

SIP Universal Measuring Machine

A Few of its Applications



Plug Gages over 4 in. Diam.



Snap Gages



Screws up to 4 in. Diam.

Made by
Societe Genevoise d'Instruments de Physique Geneva, Switzerland.

The Only Measuring Machine that Completely Eliminates the Personal Element

Three Sizes: 20-inch, 40-inch and 80-inch, with accessories for the Checking and Control of all forms of Standards and Gages, such as: Plug and Ring Gages, Snap Gages, Limit Gages, every element of Thread Gages and Screws, End Standards, Gage Blocks, etc.

The partial turn of an adjusting nut by hand instantly sets the machine for making EXTERNAL or INTERNAL MEASUREMENTS.

May also be used as a high-precision comparator.

Ask for Catalog No. 234

THE GOLDEN COMPANY

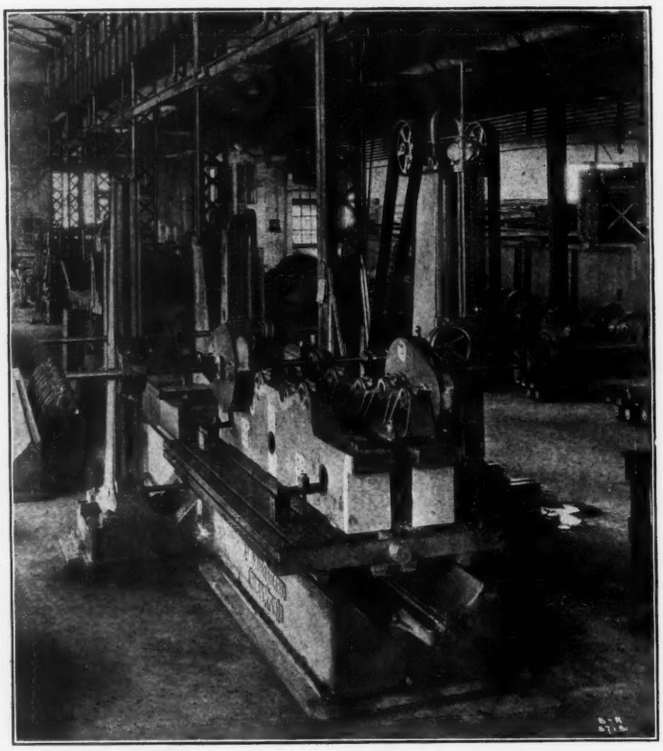
Exclusive Agents in the United States

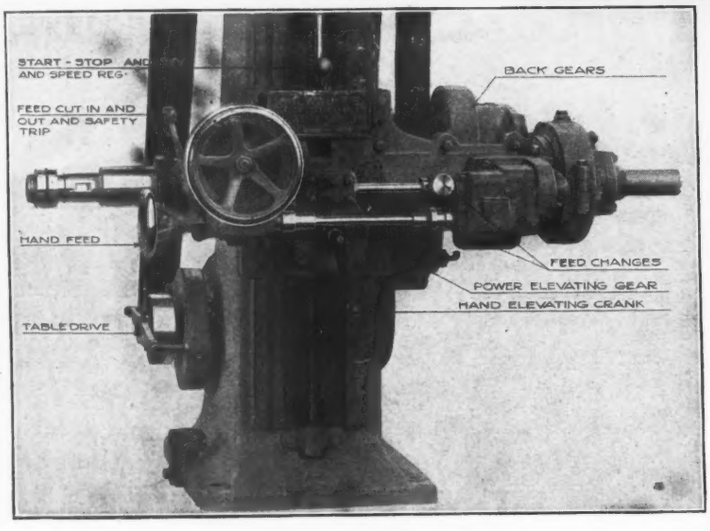
405 Lexington Avenue NEW YORK

Detroit Office: 66 West Larned Street.

AN ACCURATE HORIZONTAL DRILLING AND BORING MACHINE

Designed as a general utility tool, this machine can be quickly set for drilling tapping boring or facing operations on large or small work....

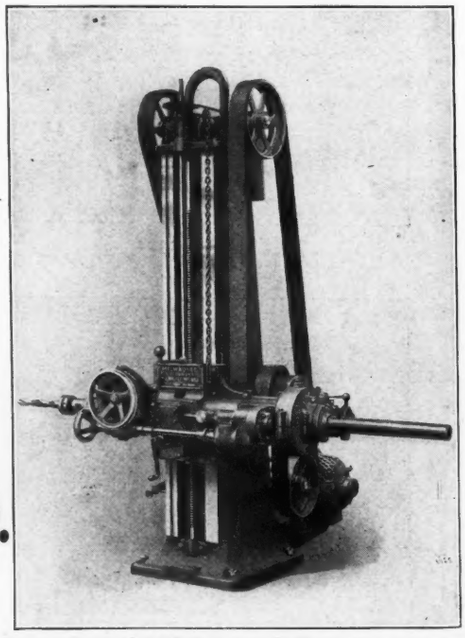




Control levers are few and are conveniently located. Power table traverse and spindle elevating gear prevents fatigue of operator....

Column may be used as a portable machine where work is too large for the table....

Write for complete information..

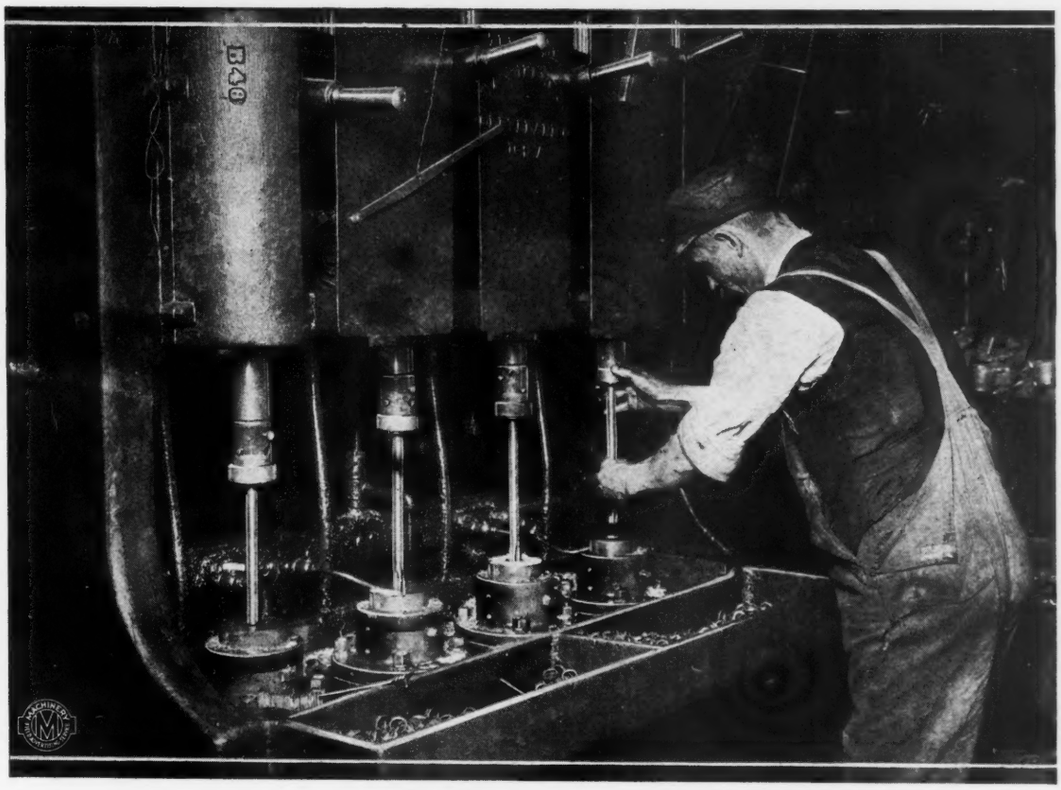


THE MILWAUKEE CRANE

MILWAUKEE ELECTRIC CRANE & MFG. CO.

MILWAUKEE, WIS.

ACME NUT TAPPING



Each Downward "Stroke" of the Spindle Threads Twenty-four Nuts

Tapping lock nuts for use in electrical apparatus is the regular job of this six-year-old Four-spindle Acme Nut Tapper in the Appleton Electric Company's shop at Chicago. Half-inch nuts were being tapped when the above picture was taken; output was 5,000 per hour, 45,000 per nine-hour day.

This production is made possible by the distinctively long and powerful "thrust" of the spindles and the fact that each spindle is provided with a counter-weight which facilitates handling and eliminates tap breakage, such as is common where the taps are started too suddenly in the nuts.

Acme Back-geared Nut Tapping Machines have quick-acting sockets and adjustable nut holders which can be loaded and unloaded with the machine running at full speed. Two sizes of work can be tapped at correct cutting speeds, or spindles can run at same speeds if desired.

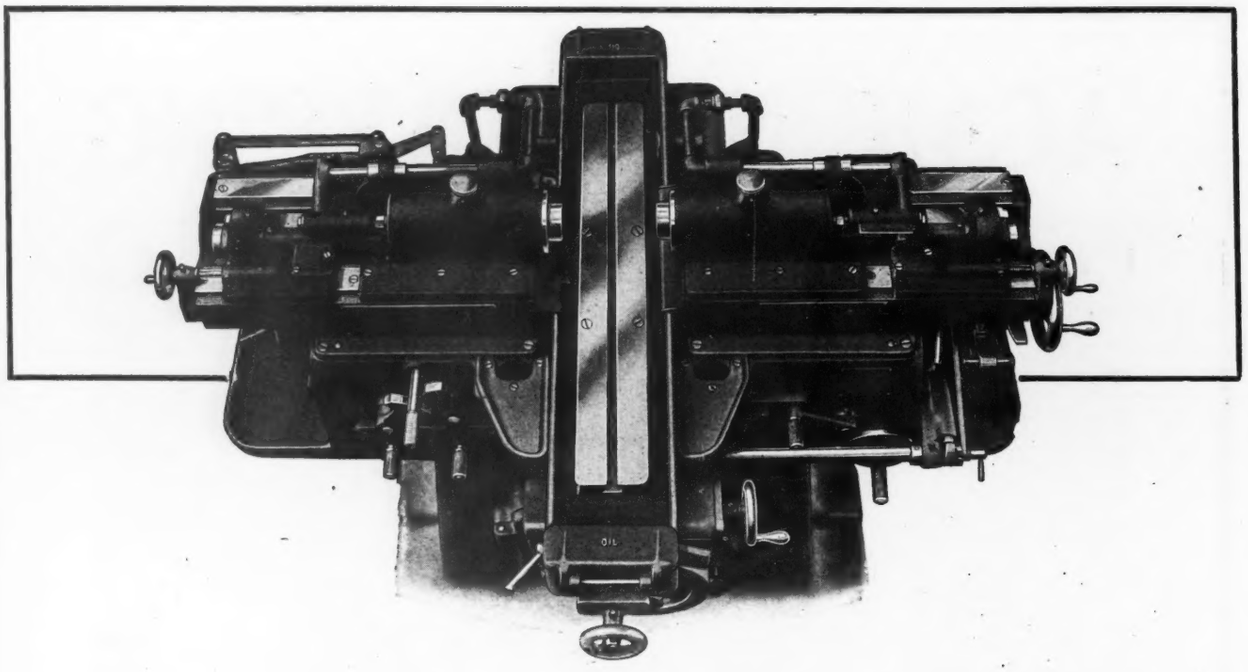


Catalog describes the whole line

THE ACME MACHINERY COMPANY

CLEVELAND OHIO, U. S. A.

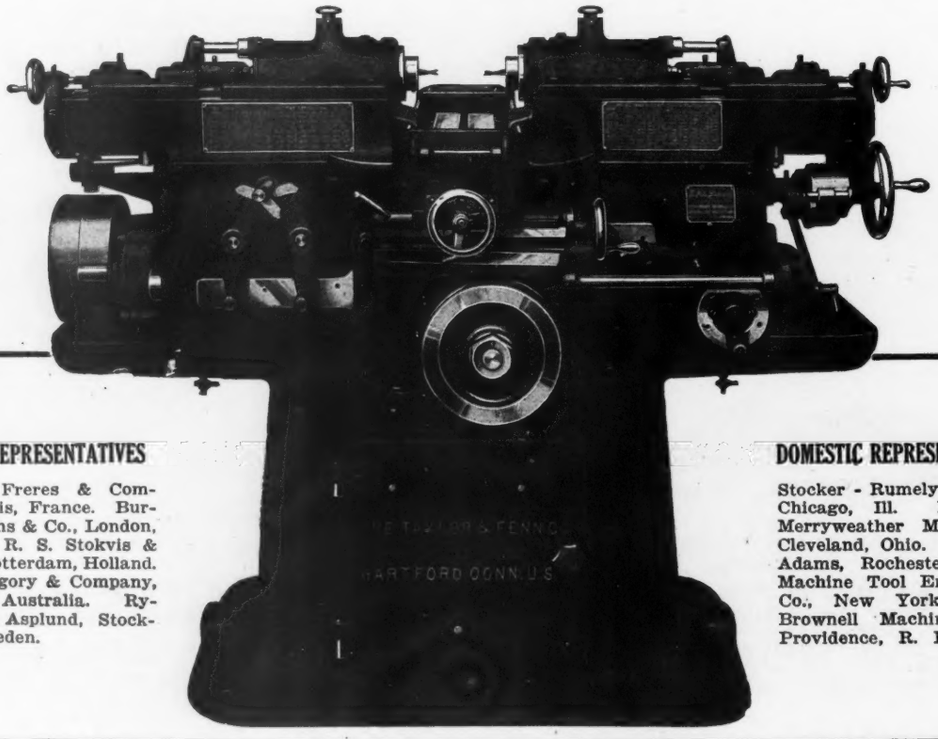
FOREIGN AGENTS: BURTON, GRIFFITHS & COMPANY, Ltd., London. GLAENZER & PERREAUD, Paris, France.



A New Spline Milling Machine

Driven direct from the main line shaft. Automatic in operation. Two spindles with simultaneous or independent feeds. Quick change speeds and feeds. Will mill grooves or cuts six inches long, one inch in width. Spindles have no overhang and cutters are rigidly held in chuck of special design. Cutting fluid is delivered in uniform constant pressure through the spindle to the point of the cutter. Many other new and special features. Circular on request.

THE TAYLOR & FENN COMPANY, Hartford, Conn., U.S.A.



FOREIGN REPRESENTATIVES

Fenwick Freres & Company, Paris, France. Burton Griffiths & Co., London, England. R. S. Stokvis & Zonen, Rotterdam, Holland. H. P. Gregory & Company, Sydney, Australia. Rylander & Asplund, Stockholm, Sweden.

DOMESTIC REPRESENTATIVES

Stocker - Rumely - Wachs, Chicago, Ill. Motch & Merryweather Mchy. Co., Cleveland, Ohio. Ogden R. Adams, Rochester, N. Y. Machine Tool Engineering Co., New York, N. Y. Brownell Machinery Co., Providence, R. I.

"WHITNEY"

HAND MILLING MACHINE

THOUSANDS IN USE

Is invaluable in the LARGE FACTORY as no other design equals it for big production on interchangeable work, as proved by the thousands of these machines in constant use both here and abroad. One concern alone is using over 700 of these machines and many other concerns have over one hundred each.



Is invaluable in the SMALL SHOP as it will handle a wide variety of operations with convenience, accuracy and rapidity. Soon pays for itself.

PROMPT DELIVERIES

THE WHITNEY MFG. COMPANY

HARTFORD, CONNECTICUT

CHAINS KEYS AND CUTTERS HAND MILLING MACHINES

FOREIGN AGENTS: Burton, Griffiths & Co., Ltd., London; Fenwick Freres & Co., Paris; Rylander & Asplund, Stockholm, Sweden.

The Gabrielson Milling Machine

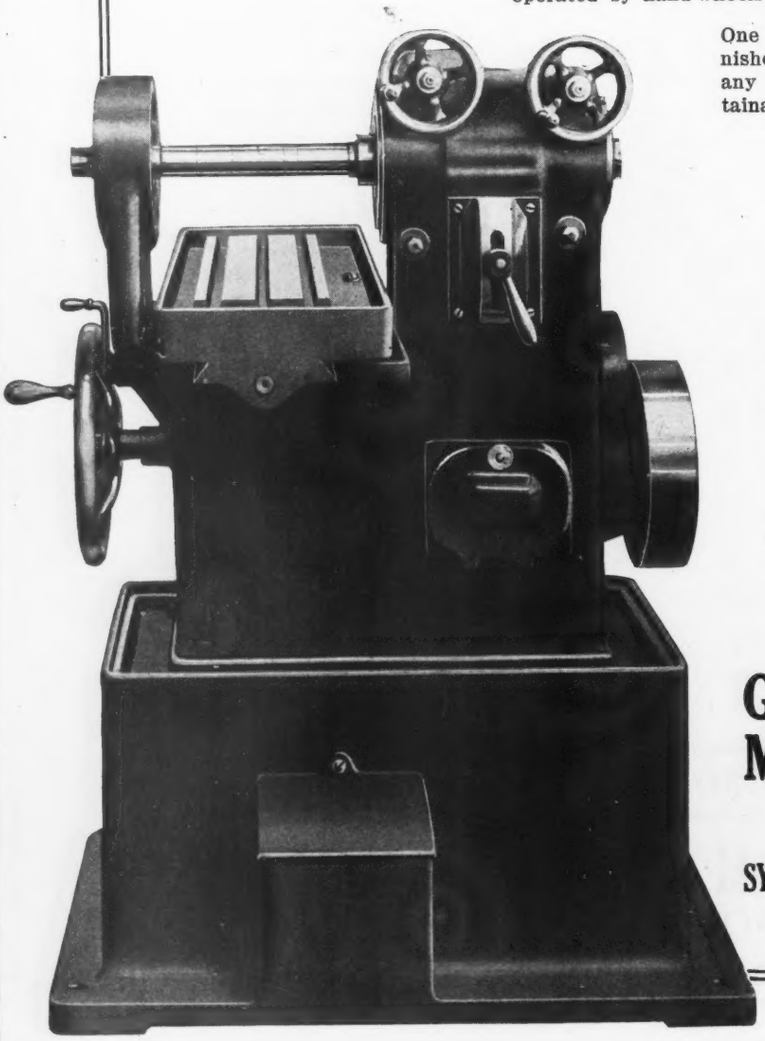
A Plain, Rigid Machine with a Practical Range for General Production

No one would hire a ten-thousand-dollar man and put him at an eighteen-dollar-a-week job, but many manufacturers use expensive universal machines day after day on a simple production job, because of the lack of plain machines sufficiently accurate to meet the demands of modern manufacturing methods.

The Gabrielson Milling Machine was designed to provide for this condition. Rigidity is its outstanding feature, so consistently developed that it takes heavy cuts without chatter and produces an excellent surface on finishing cuts.

Arbor support bearing is cast integral with the frame. Table has a working surface 34″ by 7″, and a longitudinal feed 31″ in either direction. Spindle of steel—hardened, ground and lapped—runs in bronze bushings and is carried by a large eccentric sleeve allowing 1″ vertical and ½″ endwise adjustment. Both operated by hand-wheels graduated to .001″.

One pair of gears regularly furnished provides two speeds, but any desired feed is readily obtainable through change gears.



This machine is made in three sizes—6″, 9″ or 12″ between spindle and table. Details on request.

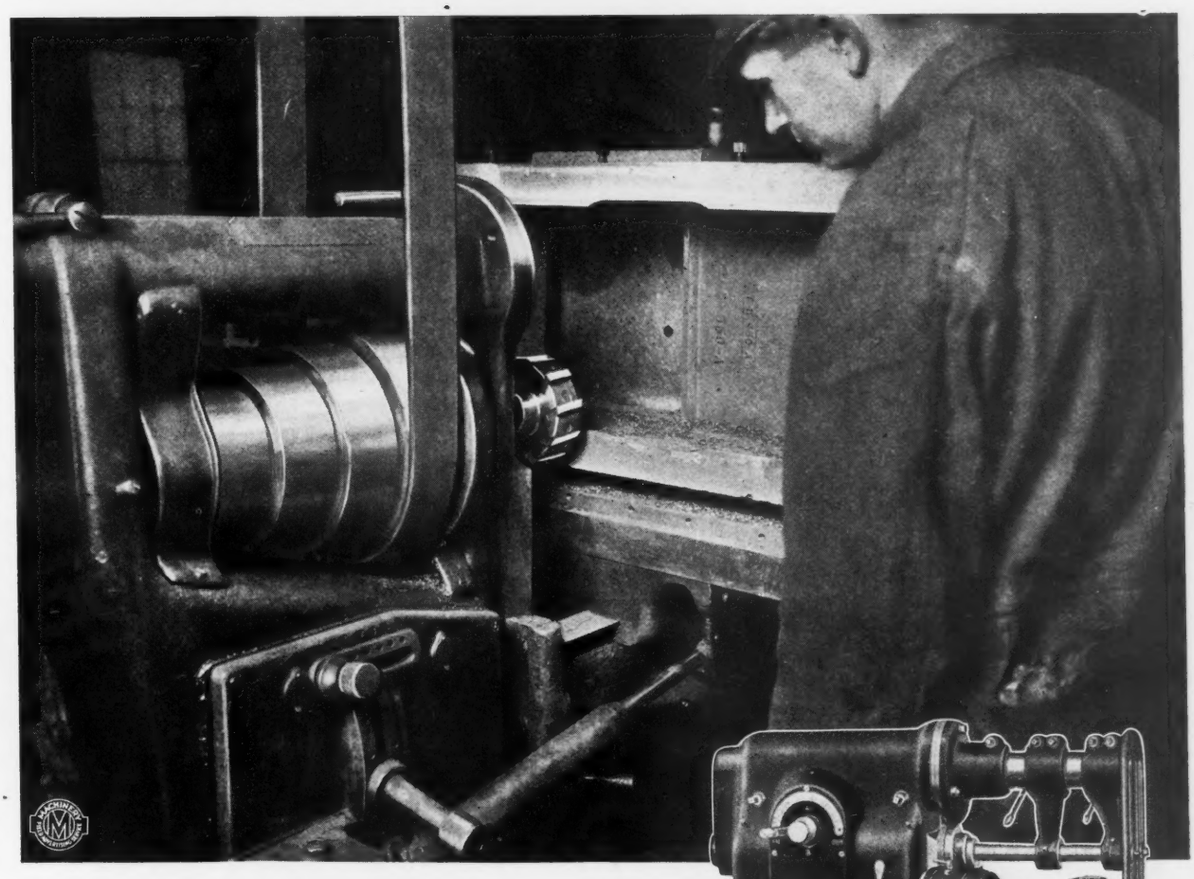
GABRIELSON MFG. CORP.

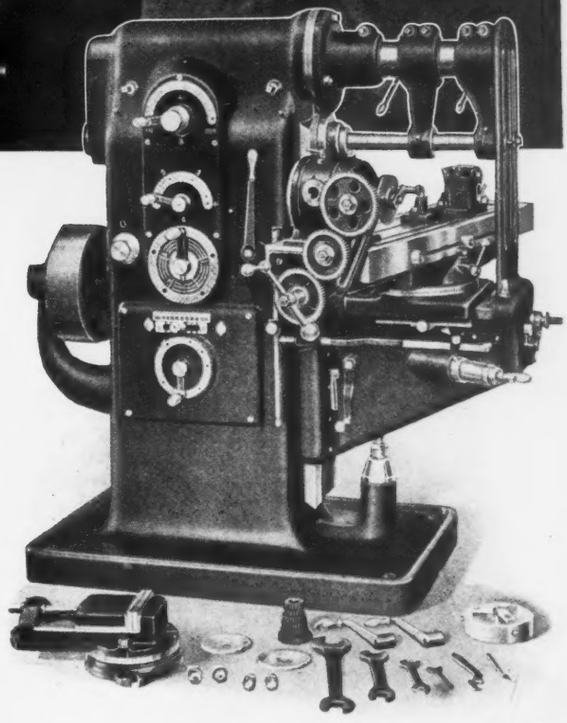
First Trust and Deposit Company Building

SYRACUSE, N. Y., U. S. A.

Milling Dust-tight Seats on a Nine-year-old

ROCKFORD MILLER





The A. M. Dellinger Co., has no hesitancy in assigning this veteran machine to handle the operation here shown—a big cast-iron gate for a coal chute. Rockford Millers have always been famous for durability, as well as their power and rigidity, and there are no chatter marks in the wake of the 6½" diameter facing mill used to make the bottom and seats of this gate "dust-tight."

In the Dellinger factory at Lancaster, Pa., they build a variety of special machinery, and this Rockford Miller is one of their standbys—a machine with more than average capacity and range.

Rockford Millers have distinctive advantages which make them favorites wherever they are installed. Let us tell you all about them.

ROCKFORD MILLING MACHINE CO.

ROCKFORD **ILL., U. S. A.**

FOREIGN REPRESENTATIVES: Great Britain, A. A. Jones & Shipman, Ltd., Leicester, England. France and Belgium, Louis Besse, Paris, France. Italy and Colonies, Societa Anonima Adler & Co., Milano, Italy. Scandinavia, Rylander & Asplund, Stockholm, Sweden, Spain and Portugal. Casamitjana Hermanos, Barcelano, Spain. Australia, Selson Engineering Co., Melbourne, Australia. Russia, M. Mett Engineering Co., Petrograd, Russia.

Briggs Milling Keyseats for La Crosse Tractors

"A Mighty Good Production Machine"



Is what they say of their Briggs Miller at the La Crosse (Wis.) Tractor Company's shop. When photographed this two-year-old machine was being used for milling 3/8" keyways 4" long in roller pinions for La Crosse Tractors.

Time is 2¼ minutes floor-to-floor, so it is not surprising to find the company "perfectly satisfied."

Briggs High Duty Millers are famous producers—powerful and accurate. Simple adjustments and conveniently located controls facilitate operation and, on certain classes of work, one man can handle a battery. More details on request.

GOOLEY & EDLUND, Inc.

CORTLAND N. Y., U. S. A.

DOMESTIC AGENTS: Vandyck-Churchill Co., New York and New Haven; Monarch Machinery Co., Philadelphia, Pa.; Lynd-Farquhar Co., Boston, Mass.; Syracuse Supply Co., Syracuse, Rochester, and Buffalo, N. Y.; Brown & Zortman Machinery Co., Pittsburgh, Pa.; English & Miller Machinery Co., Detroit, Mich.; Federal Machinery Sales Co., Chicago, Ill.; Vonnegut Machinery Co., Indianapolis, Ind.; Cleveland Tool & Supply Co., Cleveland, O.; Blackman-Hill-McKee Machinery Co., St. Louis, Mo. FOREIGN AGENTS: Burton, Griffiths & Co., Ltd., London, Manchester and Glasgow; Andrews & George, Tokyo.

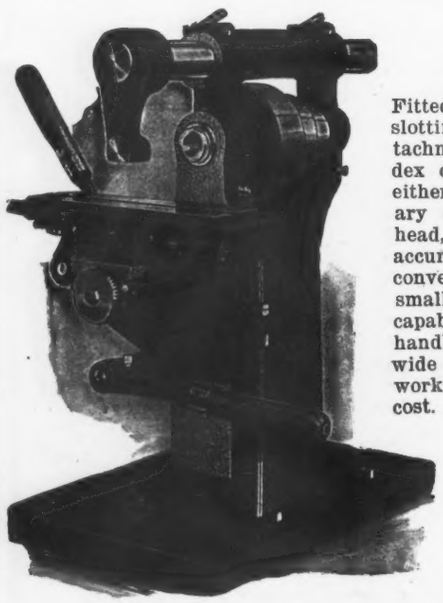
OVER-SEAS REPRESENTATIVE

ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA

51 CHAMBERS ST. NEW YORK, U.S.A.

Paris Turin Zurich Barcelona Petrograd

The Burke No. 3 Bench Milling Machine

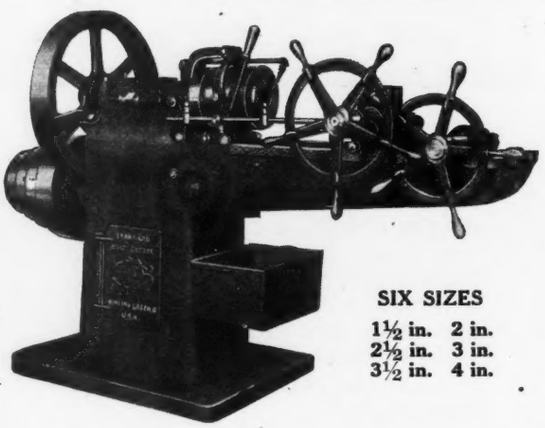


Fitted with slotting attachment, index centers—either stationary or tilting head, etc.; an accurate and convenient small machine capable of handling a wide range of work at low cost.

Catalogue lists full line of Milling Machines and attachments, also Drilling and Tapping Machines. Send for it.

The Burke Machine Tool Co.

516 Sandusky St. Conneaut, Ohio, U. S. A.



SIX SIZES

1½ in. 2 in.
2½ in. 3 in.
3½ in. 4 in.

It Took Twenty Years to Make this Bolt Cutter

Yes, this bolt cutter has been twenty years in the making—and each year has seen new improvements.

One of its many features is the adjustment which permits the machine while running to cut exact, over or under size bolts in an instant.

Complete Details on Request

THE UNIVERSAL MACHINE CO.

PIKE STREET BOWLING GREEN, OHIO

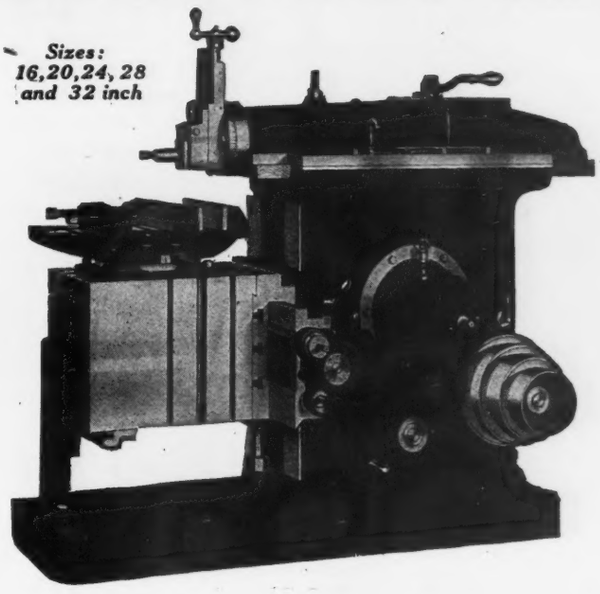
Columbia Shapers

Combine Operating and Construction Features of Unusual Merit

For instance, the quick-change feed. Is simple in design, strong and substantial and not liable to get out of order. Feed always takes place during return stroke —no danger of feeding into the work. Feed changes are easily made while machine is running by moving a handle convenient to operator. Graduations on feed box show amount of feed. A separate lever controls direction of feed. Hardened steel gears, bronze bushings, ample oiling facilities and careful workmanship insure durability.

Let us send you full details of this and other features

Sizes: 16,20,24, 28 and 32 inch



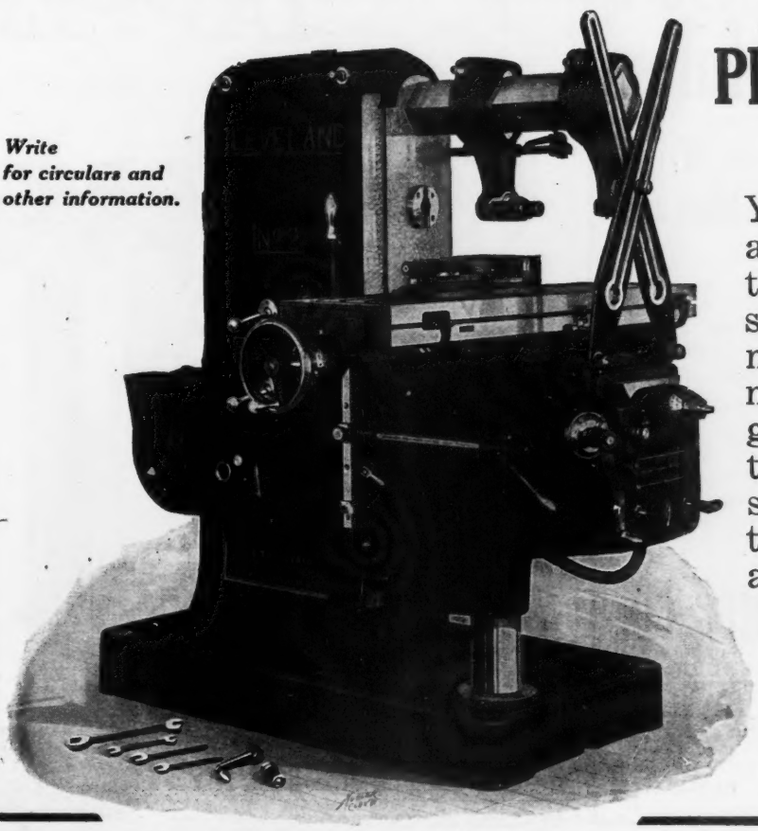
THE COLUMBIA MACHINE TOOL CO., Hamilton, Ohio

AGENTS: Manning, Maxwell & Moore, Inc., Main Office, 119 West 40th Street, New York. BRANCHES: Boston, Buffalo, Chicago, Cincinnati, Cleveland, Detroit, Milwaukee, New Haven, Philadelphia, Pittsburgh, St. Louis, San Francisco, Seattle.

CLEVELAND MILLING MACHINES

Plain and Universal

Write for circulars and other information.



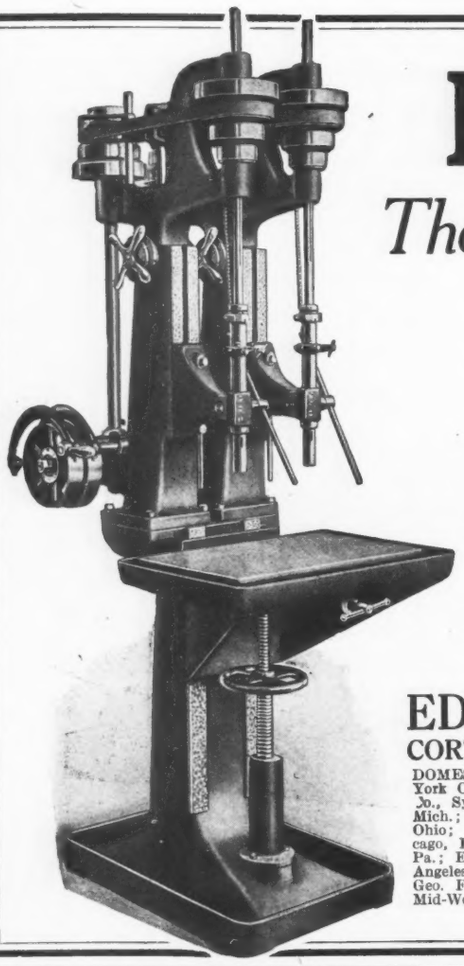
You know these machines and the high quality of their work. Made in the same plant, by the same men, with the same equipment as heretofore we can guarantee without hesitation that the same high standards will be maintained for both products and service.

The Clark-Mesker Co.

SUCCESSORS TO

THE CLEVELAND MILLING MACHINE CO.

CLEVELAND OHIO



EDLUND

The Peak of Drilling Efficiency

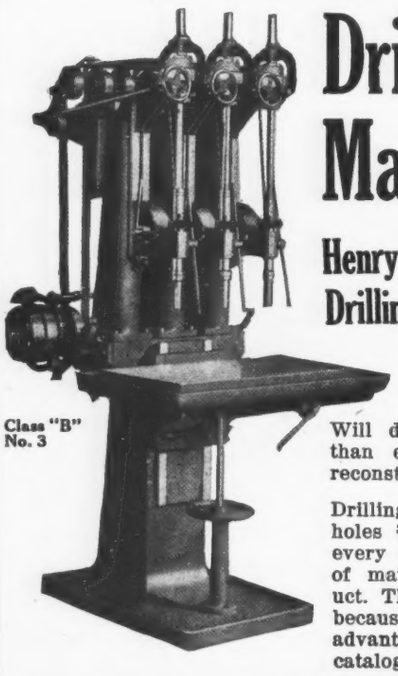
The peak is reached in Edlund Sensitive Drilling Machines. They are rigid, rapid, accurate, convenient, durable machines which have a proved record for economy. The Edlund No. 2 has one piece frame above base, extra size cone pulleys, 9″ bearing for quill, 16″ knee bearing on column, ball-bearings throughout, and four changes of speed are obtainable without stopping the machine. Idler takes up slack in belt.

Edlund machines are especially adapted for tool-room service or manufacturing equipment where extreme accuracy is required. Made with 1 to 6 spindles. Ask us about the machine you need.

EDLUND MACHINERY CO., INC.

CORTLAND Box 45 NEW YORK

DOMESTIC AGENTS: Monarch Machinery Co., Philadelphia, Pa.; Vandyck Churchill Co., New York City, New Haven, Conn.; Manning, Maxwell & Moore, Inc., Boston, Mass.; Syracuse Supply Co., Syracuse, N. Y., Rochester, N. Y., Buffalo, N. Y.; English & Miller Machinery Co., Detroit, Mich.; Cleveland Tool & Supply Co., Cleveland, Ohio; The M. D. Larkin Supply Co., Dayton, Ohio; Marshall & Huschart Machinery Co., Indianapolis, Ind.; Stocker-Rumely-Wachs Co., Chicago, Ill.; W. L. Romaine Machinery Co., Milwaukee, Wis.; Thompson Machinery Co., Pittsburgh, Pa.; Elliott & Stephens Machinery Co., St. Louis, Mo.; Herberts Machinery & Supply Co., Los Angeles, Cal., and San Francisco, Cal.; Garlock-Walker Machinery Co., Toronto, Canada; The Geo. F. Foss Machinery & Supply Co., Montreal, Canada; Aumen Machinery Co., Baltimore, Md.; Mid-West Machine Tool & Supply Co., Davenport, Iowa; Gunther-Plant Co., Minneapolis, Minn.



Drilling Machines

Henry & Wright Drilling Machines

Class "B" No. 3

Will do more drilling than ever during the reconstruction period.

Drilling millions of holes ¾″ and under in every conceivable kind of manufactured product. They are preferred because of their many advantages. Send for catalogue.

THE HENRY & WRIGHT MFG. CO.

HARTFORD, CONN.

OVER-SEAS REPRESENTATIVE

ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA
51 CHAMBERS ST. NEW YORK, U.S.A.

PARIS TURIN ZURICH BARCELONA

The UNIVERSAL TAPPER

(Patent applied for)



The TWO in ONE Machine for Tapping and Threading Small Parts, either HORIZONTALLY or VERTICALLY, or in any intermediate angular position, most suitable for the work.

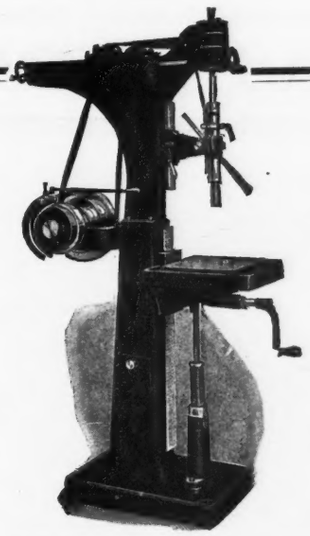
The Essential Machine for Instrument and Apparatus Manufacturers. Further details on request.

Send for Circular "M."

Manufactured by

LOWENSTEIN RADIO CO., Inc.

397 Bridge St. Brooklyn, N.Y.



Monday Morning to Saturday Night

—Overtime, Too, If Needed—

Continuous Satisfactory Service

The Avey BALL BEARING DRILLING MACHINE

The Avey Drilling Machine Company

CINCINNATI, OHIO, U. S. A.

For Drilling Cast Iron Use Speedy, Sensitive

CARLTON RADIAL DRILLS

They are profitable producers and make speed on the finest drilling work. Accurate and delicate adjustments, sensitive, convenient controls make these machines especially valuable for manufacturing work.

Capacity 1" in cast iron; 2½', 3½', or 4' arm; belt or motor drive. Details?

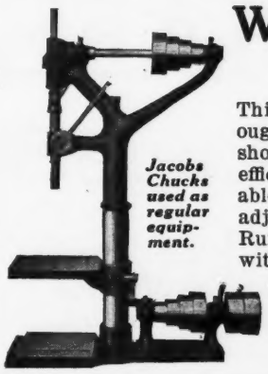


The Carlton Machine Tool Co.

2994 Spring Grove Ave.

CINCINNATI, OHIO, U.S.A.

PROFITABLE EQUIPMENT



Jacobs Chucks used as regular equipment.

Winterhoff 10½" Bench Drills

This handy little drill is thoroughly satisfactory in either shop or factory. It is sensitive, efficient, easily operated and durable. Bearings are ball thrust, adjusted for wear and end play. Runs up to 2,400 R.P.M. Made with either motor or belt drive.

0" to ½" capacity. Prompt deliveries

WINTERHOFF TOOL & MACHINE CO.

ELKHART INDIANA

TUTTLE TAPPERS

FOR SMALL TAPPING WORK

Light-weight machines, rigid, accurate and speedy. Made in bench and pedestal types for hand or foot lever operation. Equipped with automatic stop that can be set to the desired depth and makes tapping safe on blind or through holes.

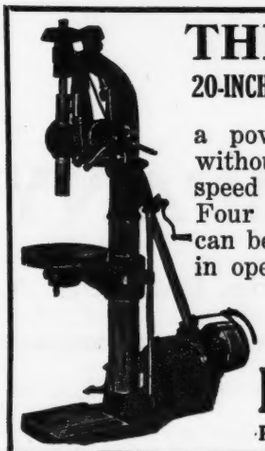


Capacity to ¼" tap. Height, 15". Base, 13" x 16". Diameter of swing table 11½". Clearance of tap spindle to column 6". Vertical adjustment of table 3". Speed of countershaft up to 1000 R.P.M.

Circular?

PARAGON GEAR WORKS

TAUNTON (Evans Stamping and Plating Co.) MASS.



THE LINDGREN

20-INCH HIGH SPEED ALL GEARED DRILL

a powerful machine, 5 speeds without back gear. Bearing in speed box fitted with ring oilers; Four change positive gear feed; can be changed while machine is in operation. Star handle.

New lubrication features.
No leakage of oil.

Mechanics Tool Co.

ROCKFORD ILLINOIS, U. S. A.

THE LAST WORD IN



THE RICKERT-SHAFER

Reduced Tap Breakage Sev

These two photographs were taken in the plant of the Johnson Motor Wheel Company, South Bend, Indiana. One shows a Rickert-Shafer Tapping Machine tapping aluminum armature plates at the rate of 40 per hour. Each armature plate requires 24 holes, three different sizes, to be tapped. In other words, there are 960 holes tapped per hour by this machine.

Not only has the Johnson Motor Wheel Company found its Rickert-Shafer Tapping Machines very efficient, but with them tap breakage has been reduced 75 per cent.

RICKERT-SHAFER COMPANY

NEW YORK OFFICE: 50 CHURCH ST.

612 W. 12th Street **Erie, Pa., U. S. A.**

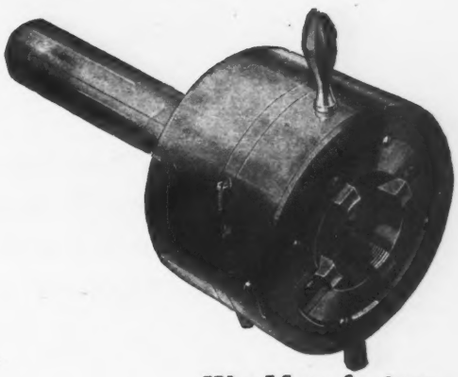
BRANCH OFFICES: 380 Rockefeller Bldg., Cleveland, Ohio; 117 N. Jefferson St., Chicago, Ill.; Bourse Bldg., Philadelphia, Pa.; 50 Church St., New York, N. Y.; 66 W. Larned St., Detroit, Mich.; 414 Elm St., Cincinnati, Ohio.

THREADING TOOLS



TAPPING MACHINE

enty-five Per Cent.



The second machine in this installation is tapping (brass) gasoline inlets in carbureters, 5/16"—24 threads per inch, 3/8" deep blind holes. There is one hole in each carbureter and production is 400 carbureters per hour.

Write for our interesting booklet on tapping machines and methods.

We Manufacture Die Heads Also

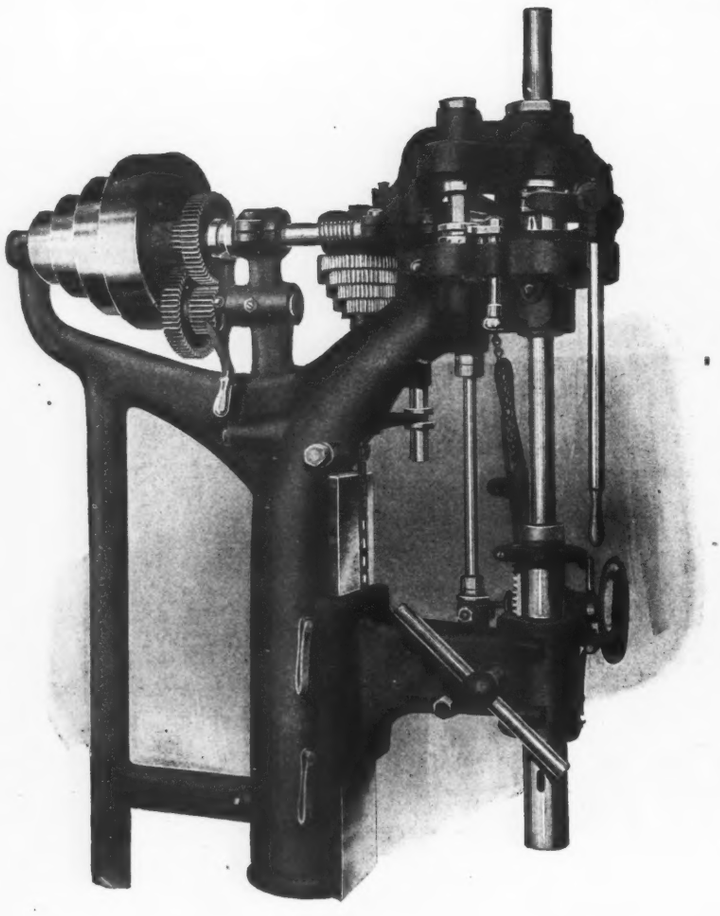
RICKERT-SHAFER COMPANY

NEW YORK OFFICE: 50 CHURCH ST.

612 W. 12th Street **Erie, Pa., U. S. A.**

AGENTS: Vonnegut Machinery Co., Indianapolis, Ind.; Stocker-Rumely-Wachs, Chicago, Ill.; Strong, Carlisle & Hammond, Cleveland, Ohio; Michigan Metal Supply Co., Detroit, Mich.; Peter Frasse & Co., New York, N. Y.

The Driller that saves



Hoefer Time-saver No. 1
The Tapping Attachment

90% would be a conservative estimate of the time and cost-saving of tapping on the same machine that does the drilling. And the Hoefer Geared Tapper only requires lowering or raising a small knobbed shaft to set the attachment in action or to disengage it.

Hoefer Time-saver No. 2
Changing Feeds

In our geared feed we have one of the most convenient and rapid arrangements in existence. Without leaving his position and on even the largest sizes of drillers the operator can instantly change the feeds while the drill is in action.

Hoefer Time-saver No. 3
Driving out the Drill

You don't have to use valuable time locating a spindle hole and a spindle sleeve hole and then aligning them before you can get the drift in to drive out the drill. The Hoefer way is simply to drive the drift into *one* hole and then knock out the drill.

These are a few of the outstanding Time-Savers of Hoefer Drillers. They illustrate one of the guiding principles of Hoefer design—to make a machine that will shorten the time on each job and help conserve the operator's energy.

HOEFER
FREEPORT

SALES ENGINEERS FOR HOEFER HEADS: Chicago, 621 Washington Blvd.; New York, 30 Church St.; Philadelphia, Bourse Bldg.; Buffalo, Ellicott Square Bldg.; Cleveland, Citizens Bldg.; Pittsburgh, Empire Bldg.; Detroit, 602 Kerr Bldg.; Milwaukee, Majestic Bldg.; Dayton, John M. Howett, 12 W. Second St.; St. Louis, Colcord-Wright Machinery & Supply Co.; Minneapolis, F. E. Seatterlee Co.; Montreal, Canadian Fairbanks-Morse Co. (head office).

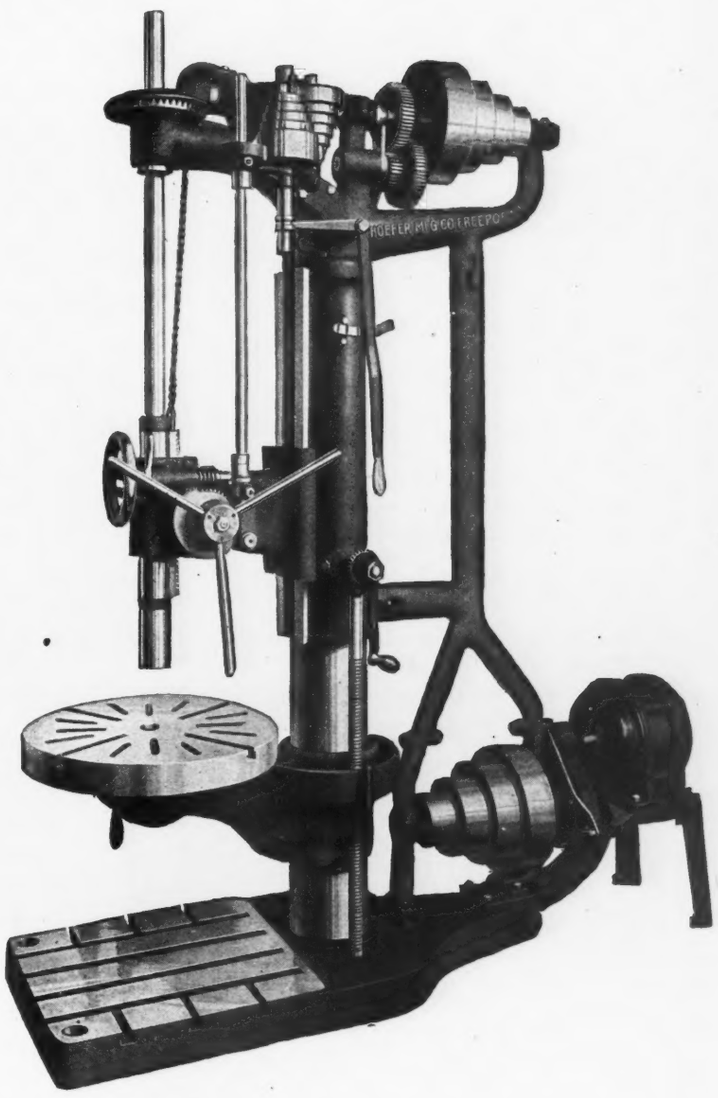
Time—and why

The big and little conveniences and time-savers on Hoefer Drillers also show another Hoefer characteristic—a *practical* driller designed by *practical* engineers closely in touch with operating problems and eternally plugging away to make a better machine.

And remember that saving time is only one of the strong points of a Hoefer Driller. It's built for accurate work, for hard service and for long use. And it meets all of these specifications, too—as any of the hundreds of satisfied users can tell you.

Whether you suspect that your drilling equipment is not fully up to the topnotch standard, or consider your drilling operations satisfactorily performed, it will be worth your while to make sure by taking advantage of Hoefer Consultation Service. It's offered without charge or obligation. If we can help you, we'll prove it, and if we can't, we'll say so frankly.

Write for catalog.



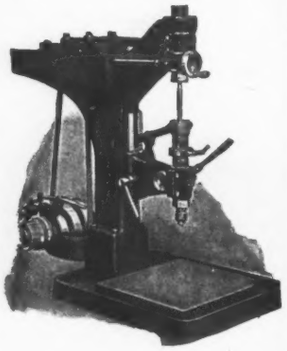
M'F'G Co.

ILLINOIS

SALES OFFICES FOR HOEFER DRILLERS: Baltimore, Aumen Machinery Co., 107 E. Lombard St.; Boston, Factory & Mill Supply Co.; Providence, Brownell Machinery Co.; New York, F. H. Niles & Co., Woolworth Bldg.; Philadelphia, Luster Machinery Co., 917 Arch Street; Syracuse, C. H. Wood Co.; Rochester and Buffalo, Ogden R. Adams; Pittsburgh, Motch and Merryweather Machinery Co.; Cleveland, Cleveland Tool & Supply Co.; Dayton, John M. Howett, 12 W. Second St.; Indianapolis, E. A. Kinsey Co.; Detroit, Cadillac Tool Co.; Chicago, Federal Machinery Sales Co., 12 N. Jefferson St.; Milwaukee, Badger Packard Machinery Co.; Minneapolis, F. E. Satterlee Co.; St. Louis, Colcord-Wright Machinery & Supply Co., Atlanta, Walraven Co.; Birmingham, Young & Vann Co.; New Orleans, Oliver H. Van Horn Co.; Seattle, Portland, Ore., San Francisco, Los Angeles, Eccles & Smith Co.; Montreal, Canadian Fairbanks-Morse Company, (head office) for all Canada.

IT PAYS TO SPECIALIZE

THE MACHINE THAT IS EXACTLY SUITED TO ONE JOB WILL NOT DO FOR SOME OTHERS



No. ½
Speed 12000 R. P. M.
No Vibration
No Heating

Specially designed for very light drilling where speed is the essential. Eliminates Twist Drill Breakages.

Get the Right Machine for Your Work

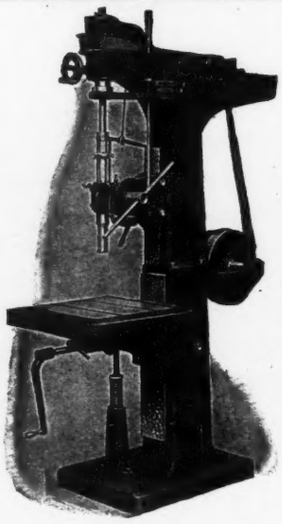
THERE ARE **8** OTHER SIZES AND TYPES OF

Avey

Ball Bearing Drilling Machines

Each Particularly Suited to Certain Classes of Work

These include: 4 sizes standard manufacturing type, 2 sizes—tool room, round table types and automatics. Let's talk it over. Give us your inquiries.



No. 3, Heavy Duty

Will drill holes ¾" to 1⅛" at highest speeds, assuring clean work

THE AVEY DRILLING MACHINE CO., CINCINNATI, O.



THE MORRIS RADIAL

is a Popular Machine in the Plants of Pump and Compressor Manufacturers

Quick positioning, speed, accurate work—all are important points in the drilling, boring, reaming, etc., of pump and compressor parts. That's what the Advance Pump & Compressor Co., Battle Creek, Mich., will tell you—that's why they use the Morris Radial Drill.

The Morris is shown here drilling 15/16" holes in "Advance" pump heads, work which it handles with both speed and precision. Write for Catalog.

THE MORRIS MACHINE TOOL COMPANY

CINCINNATI **OHIO, U. S. A.**

REPRESENTATIVES: Niles-Bement-Pond Company, 111 Broadway, New York City, N. Y., Boston, Mass., Chicago, Ill., Detroit, Mich., Philadelphia, Pa., Pittsburgh, Pa., Plainfield, N. J., St. Louis, Mo. Niles Tool Works Co., Cleveland, O., Hamilton, O. Pratt & Whitney Company, 16 Fremont St., San Francisco, Cal., Birmingham, Ala., Cincinnati, O. The John Bertram & Sons Co., 1002 C. P. R. Building, Toronto, Ontario, Montreal, Quebec, Dundas, Winnipeg, Manitoba. The Selson Engineering Co., Ltd., London, England and Turin, Italy. Messrs. Glaenzer & Perreaud, Paris, France. Henri Benedictus, Brussels, Belgium. The Taisho Trading Co., Ltd., Tokyo, Japan. A-B Sigfr. Andersson & Co., Malmo Sweden and Christiania, Norway.

A Hammond Radial, of Course

HAMMOND HIGH SPEED RADIAL DRILLING AND TAPPING MACHINES

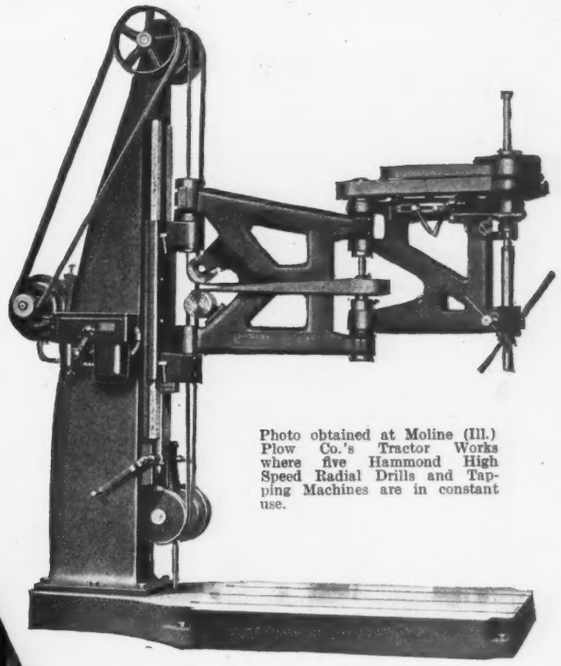
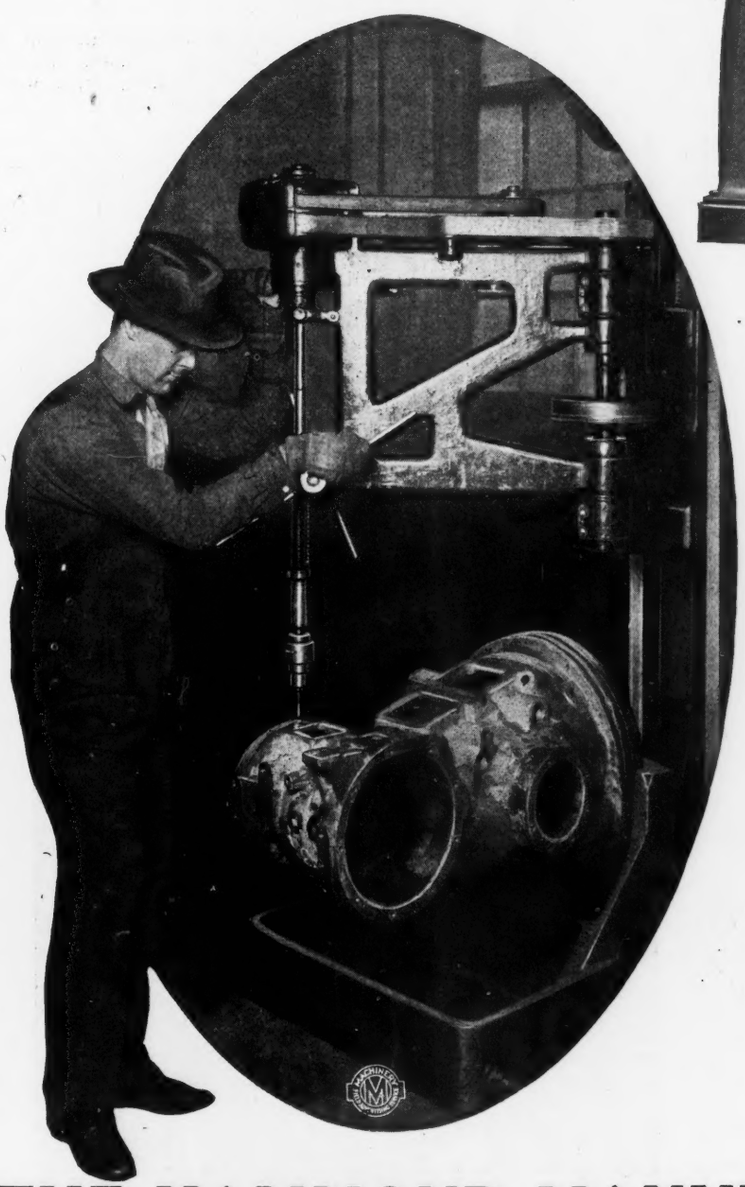


Photo obtained at Moline (Ill.) Plow Co.'s Tractor Works where five Hammond High Speed Radial Drills and Tapping Machines are in constant use.



Thirty-two Holes, Three Positions, Eight Minutes—Floor to Floor

The work is 300 lbs. cast-iron transmission cases, the operation as follows:

12 holes tapped 3/8", 16 U. S. standard, 3/4" deep.
1 hole tapped for 1/8" pipe, Briggs standard.
2 holes tapped 1/2", 13 U. S. standard, 1" deep.
17 holes tapped 7/16", 14 U. S. standard, 1" deep, blind.

The case is mounted on an indexing fixture and indexed twice during the above cycle of operations, which makes the output seem impossible to anyone not familiar with the speed and flexibility of Hammond Radial Drilling and Tapping Machines.

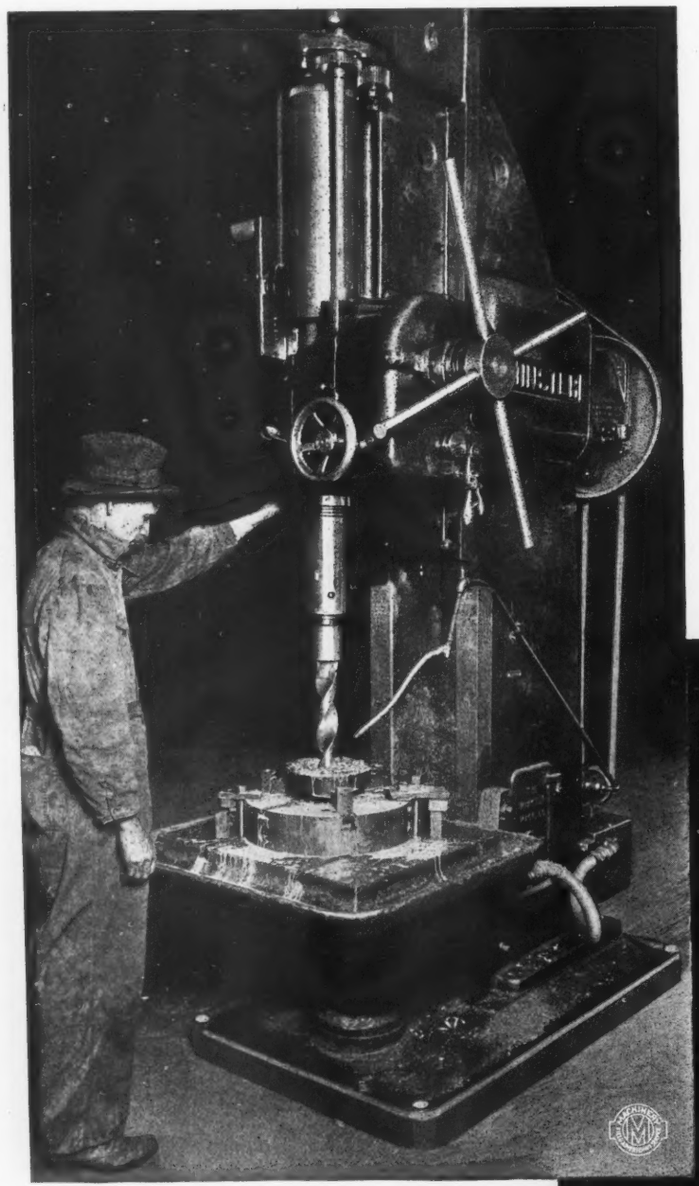
We'll be glad to describe them.

THE HAMMOND MANUFACTURING CO.

CLEVELAND **OHIO, U. S. A.**

FOREIGN REPRESENTATIVES: Fenwick Freres & Company, France and Belgium. Burton, Griffiths & Co., British Isles, Andersen, Meyer & Co., China. Andrews & George Company, Japan.

Minster Hi-Duty Drills

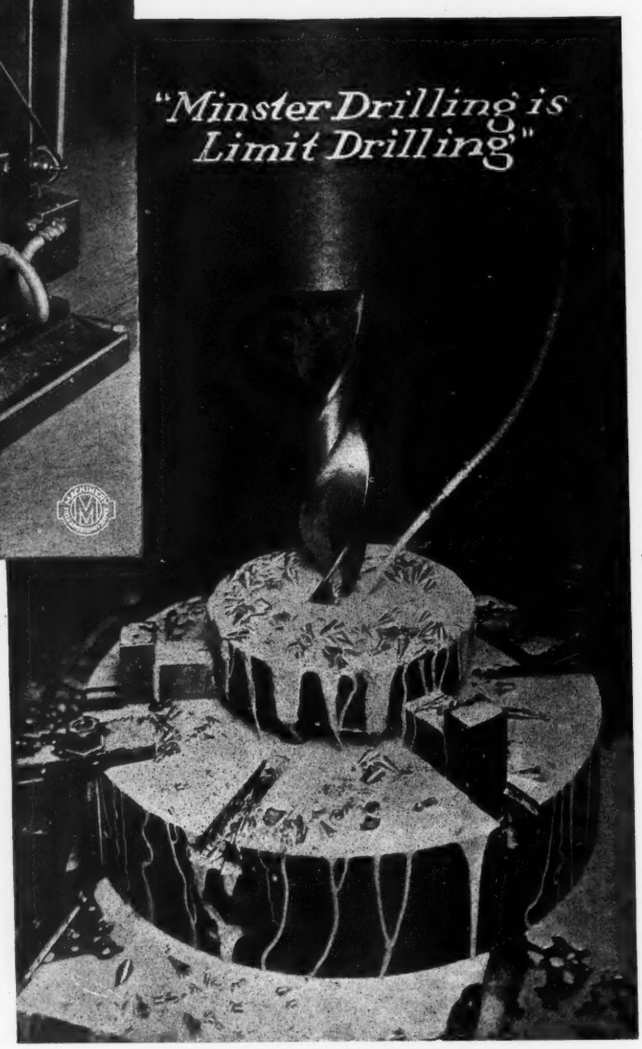


Show Accuracy, Range and Speed on a Wide Variety of Work in This Shop.

Houston, Stanwood and Gamble Company (Covington, Kentucky), specialists in the construction of heavy duty machines, use their Minster Drills on an ever-increasing range of work. Lack of suitable jigs and fixtures has limited the size of holes tapped to 4"—as soon as the necessary tools are completed the production manager expects to machine 6" holes without difficulty.

Versatile machines that meet production demands without difficulty, Minster Hi-Duty Drills add to the capacity of the plant in which they are used. Let us tell you more about them.

The photograph shows this Minster Drill drilling a 2½" hole in a 40-point carbon steel gear blank 9" in diameter and 2½" thick. The Drill is driven at a rate of 250 R.P.M., and the operation is completed in just two minutes.

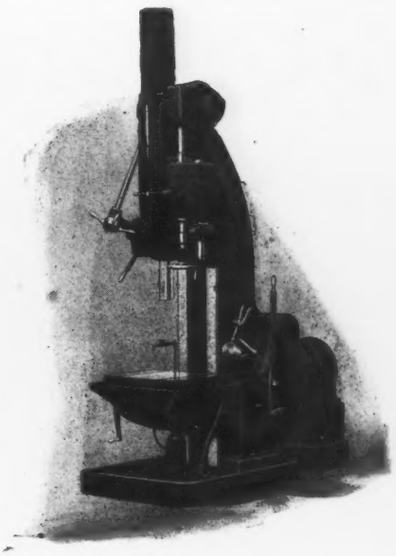


THE MINSTER MACHINE CO.

MINSTER OHIO, U. S. A.

DOMESTIC AGENTS: Barbour, Love & Woodward, Inc., 149 Broadway, New York. Machine Tool Engineering Co., 149 Broadway, New York. Syracuse Supply Co., Syracuse, N. Y. Syracuse Supply Co., Buffalo, N. Y. Syracuse Supply Co., Rochester, N. Y. Monarch Machinery Co., Philadelphia, Pa. J. S. Miller Machinery Co., Pittsburgh, Pa. Saxer Machinery Co., Erie, Pa. Cleveland Tool & Supply Co., Cleveland, O. E. A. Kinsey Co., Cincinnati, O. E. A. Kinsey Co., Indianapolis, Ind. W. J. Baird Mchy. Co., Detroit, Mich. McMullen Machinery Co., Grand Rapids, Mich. W. M. Pattison Supply Co., Toledo, O. Federal Machinery Sales Co., Chicago, Ill. Federal Machinery Sales Co., Milwaukee, Wis. Colcord-Wright Mchy. & Supply Co., St. Louis, Mo. Herberts Mchy. & Supply Co., San Francisco, Cal. Herberts Mchy. & Supply Co., Los Angeles, Cal. Wilcken-Schenk Co., Seattle, Wash. Zimmerman-Wells-Brown Co., Portland, Ore. Savage & Winter Co., Pioneer Bldg., St. Paul, Minn. Manufacturers Selling Agency, Birmingham, Ala. Oliver H. Van Horn Co., Inc., 518 Camp St., New Orleans, La. FOREIGN AGENTS: Henri Benedictus, 133 Rue Du Progress, Brussels, Belgium. Coat's Machine Tool Co., 14 Palmer St., London, England, (110-112 W. 40th St., N. Y.). Pedro Merlini, Buenos Aires, Argentine, Quinones Hardware Corp., Havana, Cuba. R. S. Stokvis & Zonen, Inc., Whitehall Bldg.; 17 Battery Place, New York; France. CANADIAN AGENTS: Williams & Wilson, Ltd., Montreal, Quebec.

THE DEFIANCE HEAVY SERVICE DRILLING MACHINE



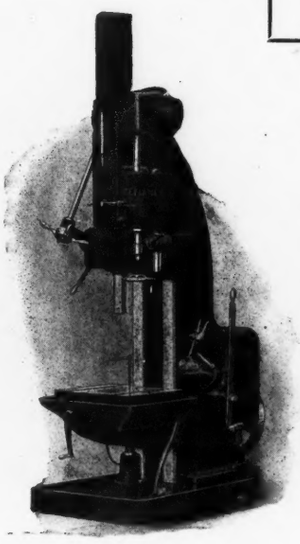
A few of the important features of this machine are:

It is entirely enclosed—permitting a gravity oiling system.

Roll-in gear mechanism for changing speeds.

Helical Gears for driving spindle.

Send for illustrated and descriptive matter covering this machine.



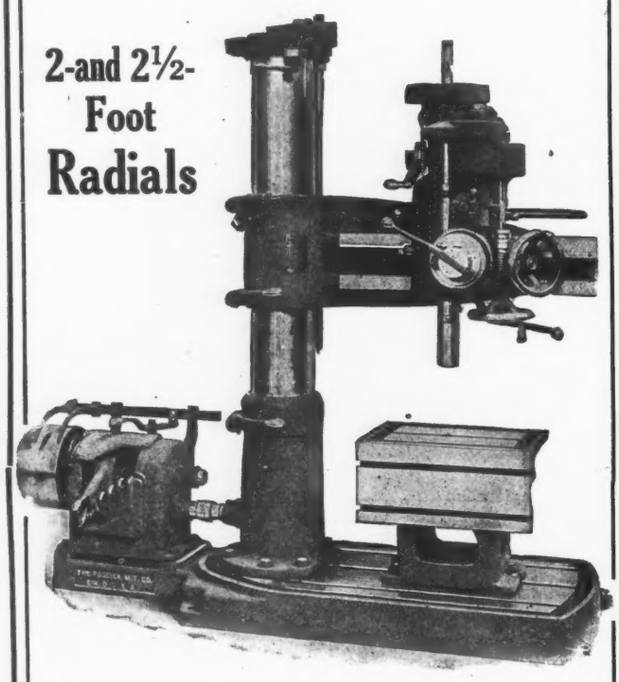
THE DEFIANCE MACHINE WORKS

DEFIANCE, OHIO, U. S. A.

NEW YORK LONDON

FOSDICK

2-and 2½-Foot Radials



Powerful, Well-built Machines With a Reputation for Speed

All geared, high speed radials, liberally supplied with ball bearings and phosphor bronze bushings, conveniently controlled and amply lubricated. No countershaft is required. A simple, positive speed box furnishes 12 speeds without stopping the machine—ample for drills from $\frac{1}{16}$" carbon to 2½" high speed steel, and for boring up to 5"—with but one speed at the pulley. Back gears, located on the head between the spindle driving gears and the reverse friction, are shifted by a single lever in front of head.

You'll want to know more about these machines. Let us send details and test sheets of actual performances.

The Fosdick Machine Tool Co.

CINCINNATI OHIO, U. S. A.

AGENTS: Biggs-Watterson Co., Cleveland, Ohio. Colcord-Wright Mchy. & Supply Co., St. Louis, Mo. Eccles & Smith Co., San Francisco, Cal., Los Angeles, Cal., Portland, Oregon. Fairbanks Co., New York City, N. Y., Hartford, Conn., Albany, N. Y. Barbour, Love & Woodward, New York City, N. Y. E. A. Kinsey Co., Cincinnati, Ohio, Indianapolis, Ind. Homer Strong, Rochester and Buffalo. Peninsular Machinery Co., Detroit, Mich. H. A. Smith Mchy. Co., Syracuse, N. Y. Swind Machinery Co., Philadelphia, Pa. Somers, Fitler & Todd Co., Pittsburgh, Pa. (radials only). Stocker-Rumely-Wachs Co., Chicago, Ill.; Milwaukee, Wis. Taylor Machinery Co., Boston, Mass. A. R. Williams Mchy. Co., Ltd., Toronto, Ont., Canada. Burton Griffiths & Co., Ltd., London, England. Fenwick Freres & Co., Paris, France. Wynmalen & Hausmann, Rotterdam, Holland. Rylander & Asplund, Stockholm, Sweden. Wilh. Sonesson & Co., Malmo, Sweden, Copenhagen, Denmark. Alfred Herbert, Ltd., Tokyo, Japan. R. L. Scrutton & Co., Sydney, Australia.

FOSDICK

Upright Drilling Machines

Higher production standards necessitate higher grade machines, and this exceptionally well made drilling machine is the logical solution of many modern drilling problems.

The friction tapping mechanism, for example, provides six times the usual tapping power, and permits withdrawing tap at four times entering speed.

There is only one speed at the pulley, but an ample supply of speeds for drilling up to 2½" is available without stopping the machine.

Positive depth gauge, automatic trip, quick return, provision for feeding tools by hand without disengaging the power feed are among the features described in our new catalog, which we'll be glad to furnish on request.

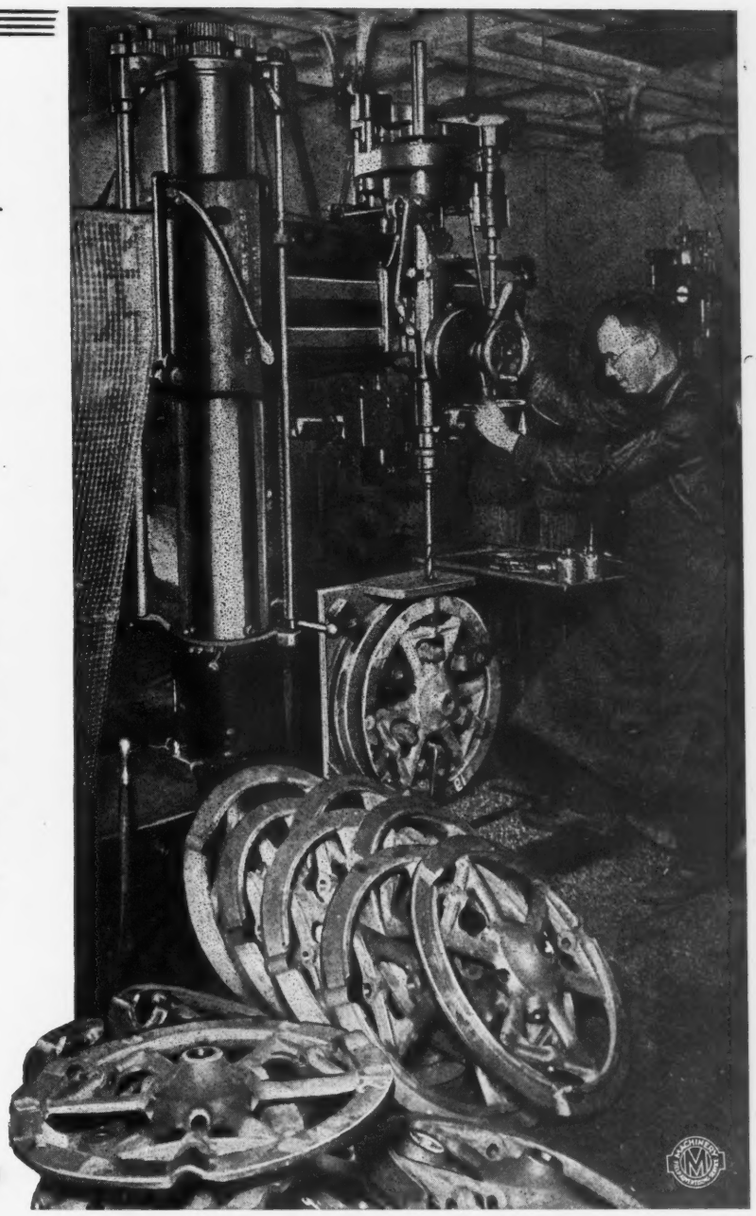


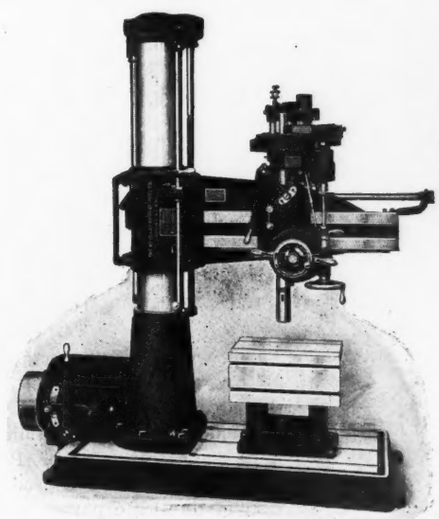
The Fosdick Machine Tool Co.

Cincinnati, Ohio

Drilling Ring Gear Centers on the MUELLER RADIAL

Six holes are drilled in each ring gear center — two on each of three center lines. An indexing jig is used to locate the holes, which are 7/8″ diameter. The power and convenience of the Mueller Radial Drilling Machine make this a real production job. Output is seven completed ring gear centers—42 holes—per hour, including handling, clamping and indexing time.





It was because of its reputation for "getting out the work" that this three-year-old Mueller Radial was assigned to this job. The reason, also, for the purchase of another "Mueller" soon after the first was installed in the La Crosse (Wis.) Tractor Company's shops.

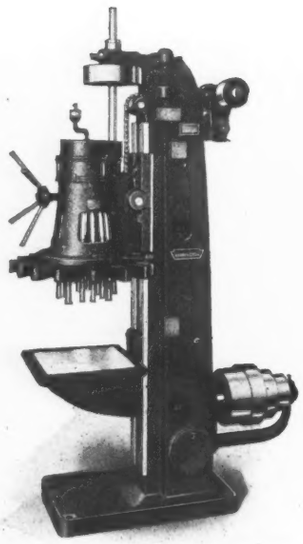
The power of the Mueller Radial centers in its patented one-piece column, reinforced its full length with four internal webs, and the long bearing of the arm on the column.

Exclusive operating conveniences and other features well worth investigating will be fully described on request.

THE MUELLER MACHINE TOOL CO.

RADIAL DRILLS AND LATHES

Cincinnati Established 1902 Ohio, U. S. A.



"A Machine of Compound Energy!"

That's the way one superintendent described a "Harrington." And he hit the nail on the head.

Harrington Multiple Spindle Drills are *crammed brimfull with energy.* They take the place of any number of ordinary "one-hole-at-a-time" drills.

HARRINGTON

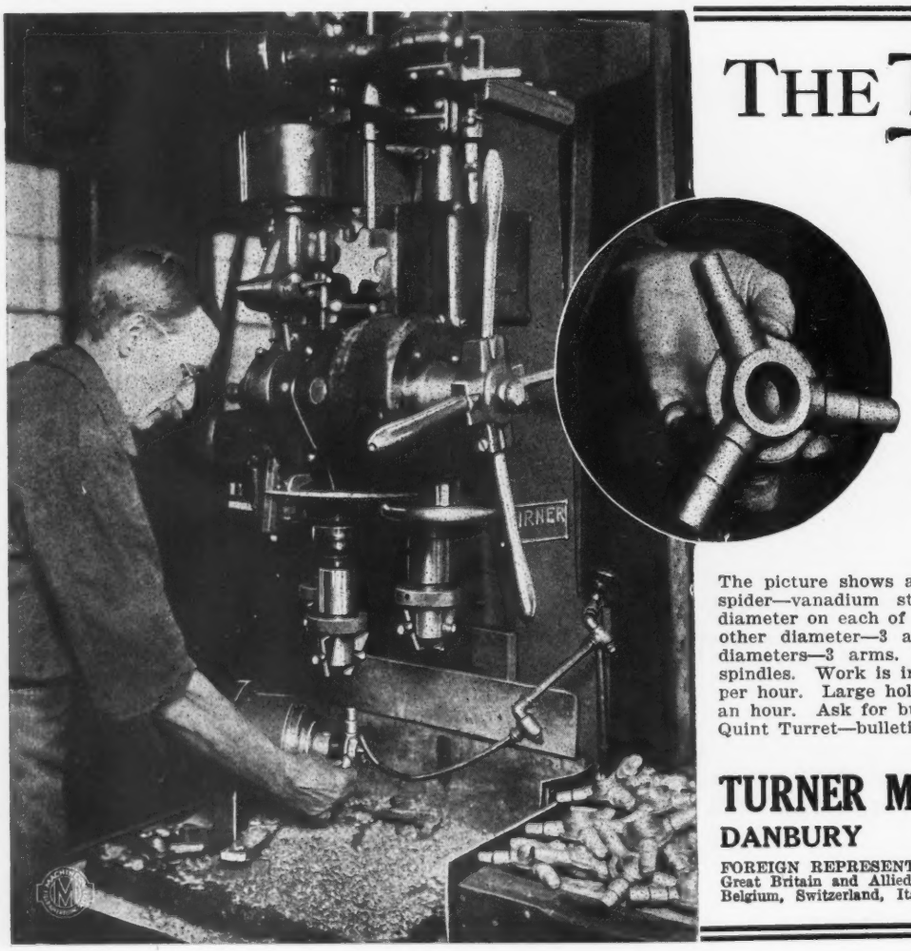
Multiple Spindle Drills

are accurate, speedy and powerful. They save floor-space, man-power and time. Their installation means *immediate* increased production.

Write for interesting Machine Tool Bulletin to-day.

EDWIN HARRINGTON, SON & CO., Inc.

PHILADELPHIA, PA.



THE TURNER TURRET

The Turner Turret is in reality a vertical turret lathe with many natural yet unusual and distinctive advantages.

The Turner Turret performs all operations at one setting of the work, and affords a convenience and adaptability uncommon to the lathe. Particularly valuable in production of duplicate parts.

The picture shows a Turner Turret on a differential spider—vanadium steel—(1) rough hollow mill one diameter on each of three arms (2) rough hollow mill other diameter—3 arms (3) finish hollow mill both diameters—3 arms. Simple touch on lever indexes spindles. Work is indexed 9 times. Production is 12 per hour. Large hole—drill, ream, face both sides, 50 an hour. Ask for bulletin IPT. Also builders of the Quint Turret—bulletin IPQ.

TURNER MACHINE COMPANY

DANBURY CONNECTICUT, U. S. A.

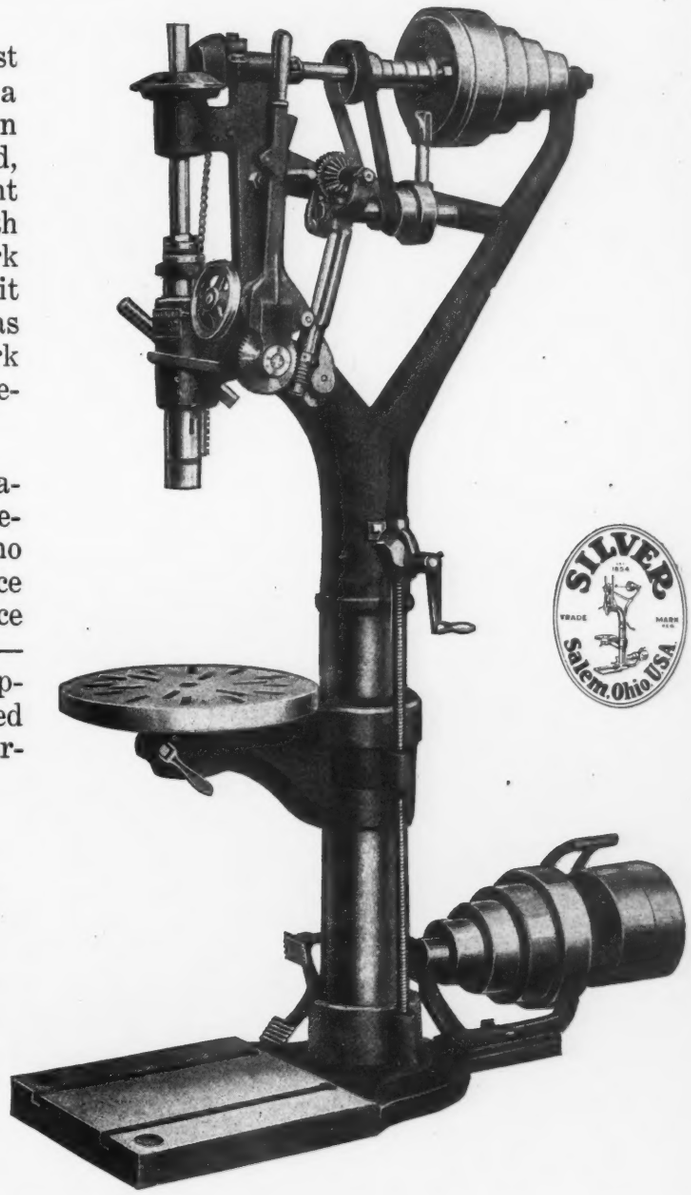
FOREIGN REPRESENTATIVES: Burton, Griffiths & Co., Ltd., for Great Britain and Allied Machinery Company of America for France, Belgium, Switzerland, Italy, Spain, Portugal.

Do machines get hard usage in your plant?
Then you will appreciate the story of

"SILVER DRILLS IN SERVICE"

The first machine set up in the first machine shop of the A. E. F. was a Silver 20″ Drill of the type shown here. It ran "Spattered with mud, drenched with rain, frozen at night and thawed by day, lubricated with any oil available——, used for work beyond its capacity or for which it was never designed," as long as it was needed; "it produced accurate work with speed——gave no trouble, required no repairs nor ever failed."

Such treatment for a high grade machine tool has never before been recorded—but necessity here left no time for care. There is no chance that the most careless shop practice would make demands such as these—yet the fact that this Silver 20″ upright Drilling machine "shouldered through without a grunt" is important to every machine tool buyer.



Silver Drills, rapid and accurate, ready for any emergency and rarely in need of repairs are made in 20″ and 25″ sizes —set up singly or in gangs. Described in our machinery catalog No. 63.

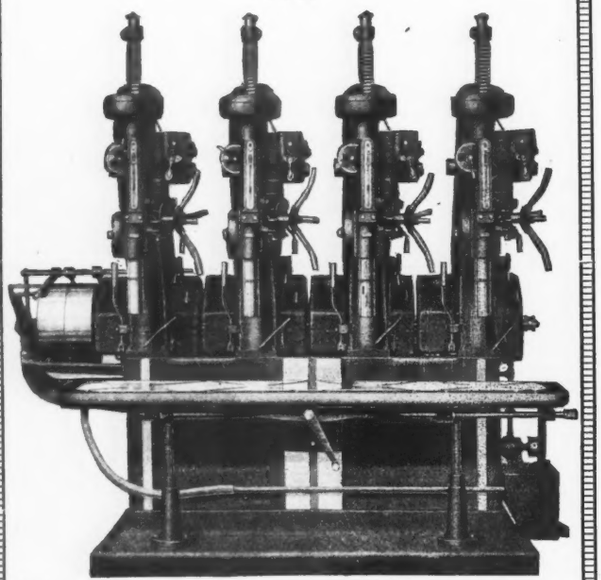
Our booklet "Silver Drills in Service" is yours for the asking; an interesting record of an interesting time, it is well worth reading—and keeping. May we send it to you?

THE SILVER MFG. COMPANY

385 Broadway SALEM, OHIO

London Paris Brussels New York Genoa Sydney Cape Town

Strictly A High Production Machine Tool



It is our 24-in. Self Oiling ALL GEARED Box Column Gang, independent geared speeds and geared feeds—eight changes of each on each spindle; also Multiple Disc Clutch Drive. Great power, speed and productive capacity. Send at once for catalog "M."

Barnes Drill Co., 814 Chestnut St., Rockford, Ill.
Inc., 1907

AGENTS FOR GREAT BRITAIN: Burton, Griffiths & Co., Ltd., London, E. C. FRANCE: R. S. Stokvis & Fils, Paris. JAPAN: Roku-Roku Shoten, Tokio. ITALY: Alfred Herbert, Ltd., Milan. SPAIN: American Machinery Syndicate, New York, Barcelona, Madrid, Seville, Bilboa, Gijon, Santander. NEW SOUTH WALES: R. L. Scrutton & Co., Sydney. BELGIUM: G. & F. Limbourg Freres, Brussels.

Rockford Horizontal Drilling Boring and Tapping Machine

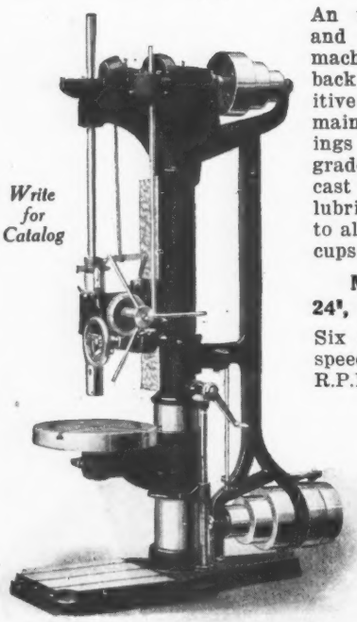
No machine in this field brings a more practical combination of strength, rigidity, endurance, accuracy and speed to its work than does the Rockford.

It has the advantage of close alignments, delicate adjustment and enormous pulling power which make it the choice for a wide range of work. It is especially adapted for the production of automobile and similar parts and is equally at home machining fine jigs.

Write for details.

THE ROCKFORD DRILLING MACHINE Co. · ROCKFORD · ILL., U.S.A.

SIBLEY HEAVY PATTERN SLIDING HEAD
Drilling Machine



Write for Catalog

An unusually heavy and powerful upright machine with double back gearing and positive geared feed. All main drive shaft bearings fitted with a high grade anti-friction die cast bearing. Ample lubrication is assured to all vital points by oil cups and reservoirs.

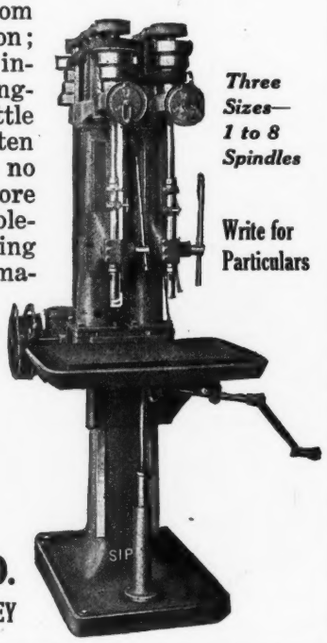
Manufactured in 24', 26' and 28' swing.

Six changes of spindle speed from 29 to 495 R.P.M. with four feeds to each speed, all selective, and 38" travel of head and table on column give exceptional capacity and range. Full description on request.

Manufactured by
SIBLEY MACHINE COMPANY
8 TUTT ST. SOUTH BEND, INDIANA, U.S.A.

Sipp Drilling and Conservation

Waste motion eats into production. Therefore waste motion is eliminated from the Sipp Drill Press, conserving the operator's energies for the special business of turning out work. Every move is made from the natural position; speed changes are instantaneous; changing belts is a little matter of about ten seconds. There's no simpler, faster, more accurate, less troublesome way of drilling than with Sipp machines.



Three Sizes— 1 to 8 Spindles

Write for Particulars

ITS A TRADE MARK SIPP

THE SIPP MACHINE CO.
PATERSON NEW JERSEY

SPEED — ACCURACY — CONVENIENCE

Demco DRILLS

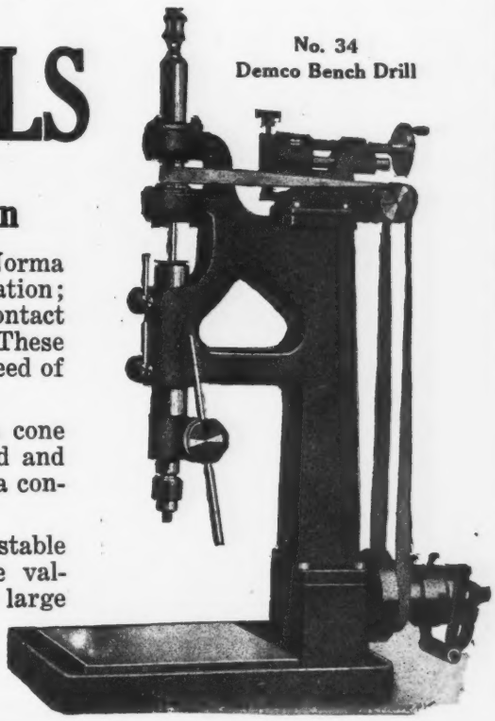
For Economical Precision Production

Heavy, carefully balanced construction insures rigidity; Norma Annular Ball Bearings throughout insure ease of operation; special automatic belt-take-up which keeps the belt in contact with the pulley at all times, insures a constant drive. These features enable Demco Drills to be run at a maximum speed of 12,000 R.P.M. practically without vibration.

Speed changes are quickly made by shifting belt on a cone pulley. Lubrication is provided by means of sight feed and spring oilers; belt-shifting is accomplished by means of a conveniently placed hand lever.

All Demco Drills are provided with the Demco Adjustable Quill Bracket and an improved Depth Gage, and are valuable in the production of extremely accurate work in large quantities.

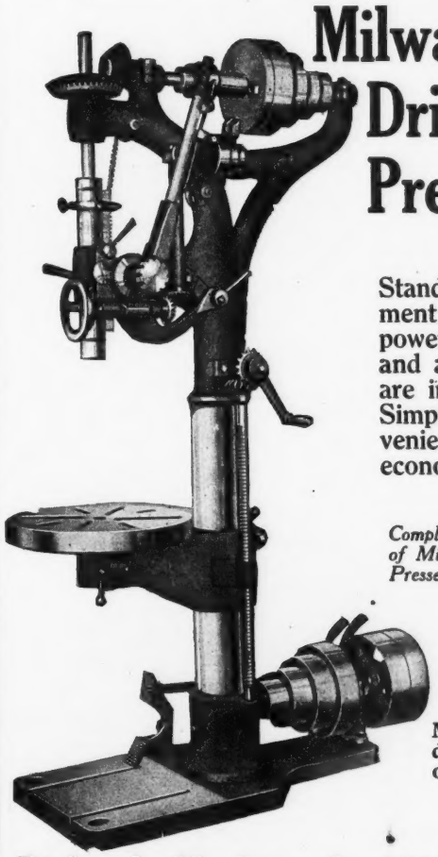
For details of No. 34 and No 36 (Floor Type) Heavy Model Drills send for our circular.



No. 34
Demco Bench Drill

DEMCO MACHINE TOOL COMPANY
CLEVELAND OHIO, U. S. A.

Milwaukee Drill Presses



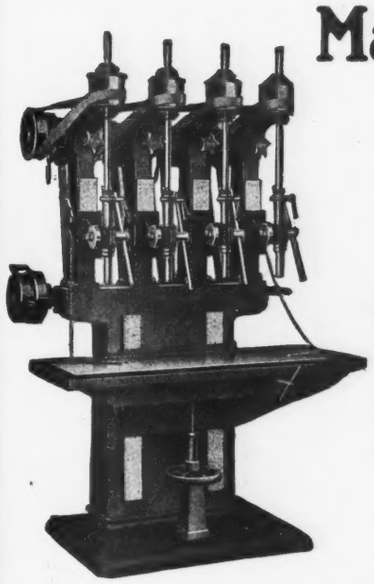
Standard equipment where power, speed and accuracy are in demand. Simple, convenient, and economical.

Complete description of Milwaukee Drill Presses on request.

Machine shown drills to center of 21¼" circle.

Richards Machine Co. 3417 VLIET STREET MILWAUKEE, WIS.

High-Grade Ball-Bearing
Sensitive Drilling Machine

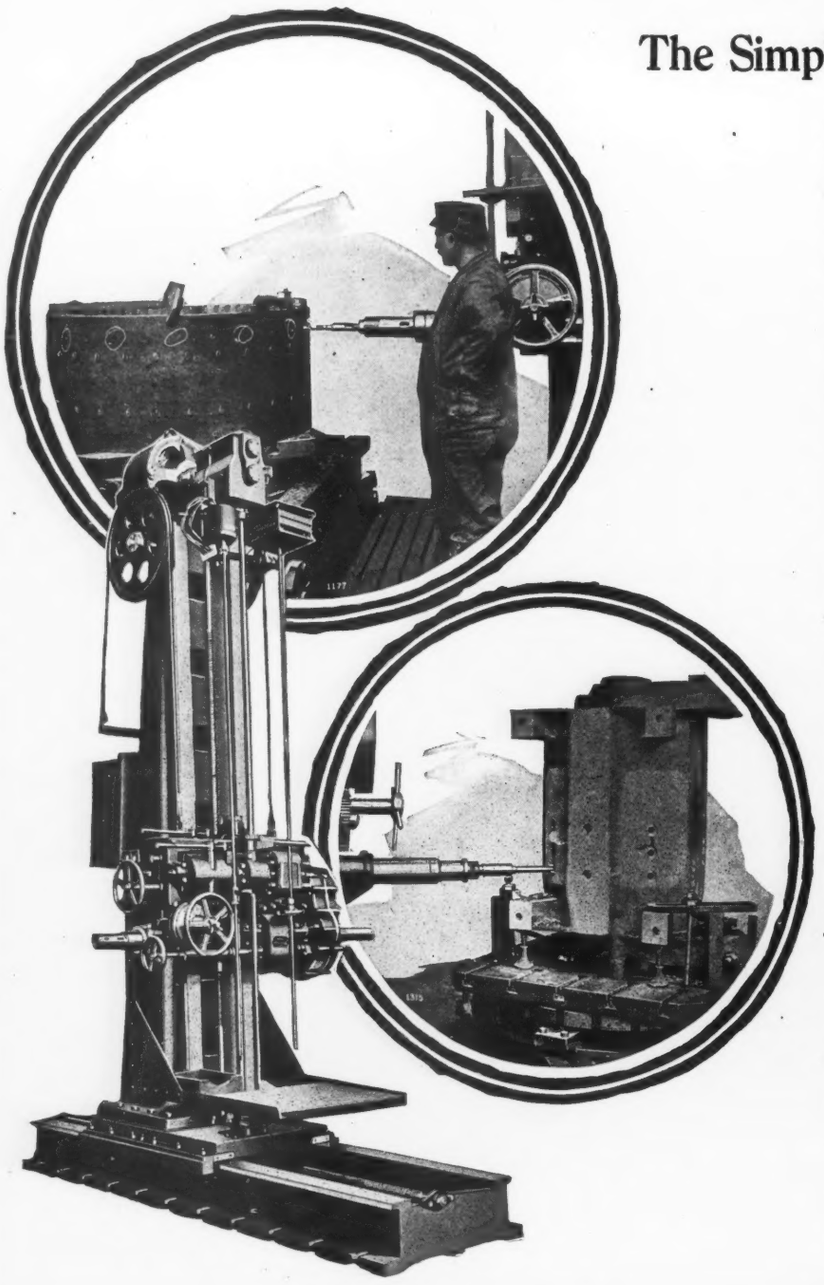


With One to Four Spindles, With 7/8" capacity

MANUFACTURED BY
FRANCIS REED COMPANY
43 Hammond Street Worcester, Mass.

P&H (HORIZONTAL) drilling and boring machines

CRANES - HOISTS - MONORAILS



The Simplicity of Efficiency

Machines, equipment, methods that are "just right" usually seem almost elemental in their simplicity—the highest degree of efficiency is reached where every waste motion, every superfluous part is eliminated. Accurate work and economical handling methods—prime necessities in the development of P&H Cranes, Hoists and Monorail systems—are assured by the horizontal boring and drilling machines and accessories developed by us to handle the heavy unwieldy pieces that make up our products.

The simplicity of these machines, their compact design and operating conveniences make them valuable equipment everywhere. Used with a work table mounted on a standard gage track (permitting the work to be transferred from one machine to the other without resetting) and such accessories as the turn table, offset drill arm, and facing head, their range and capacity are tremendously increased.

P & H Horizontal Drills and Boring Machines are made in two types and several sizes. Our Bulletin 214 describes these machines and their efficient accessories. May we send it?

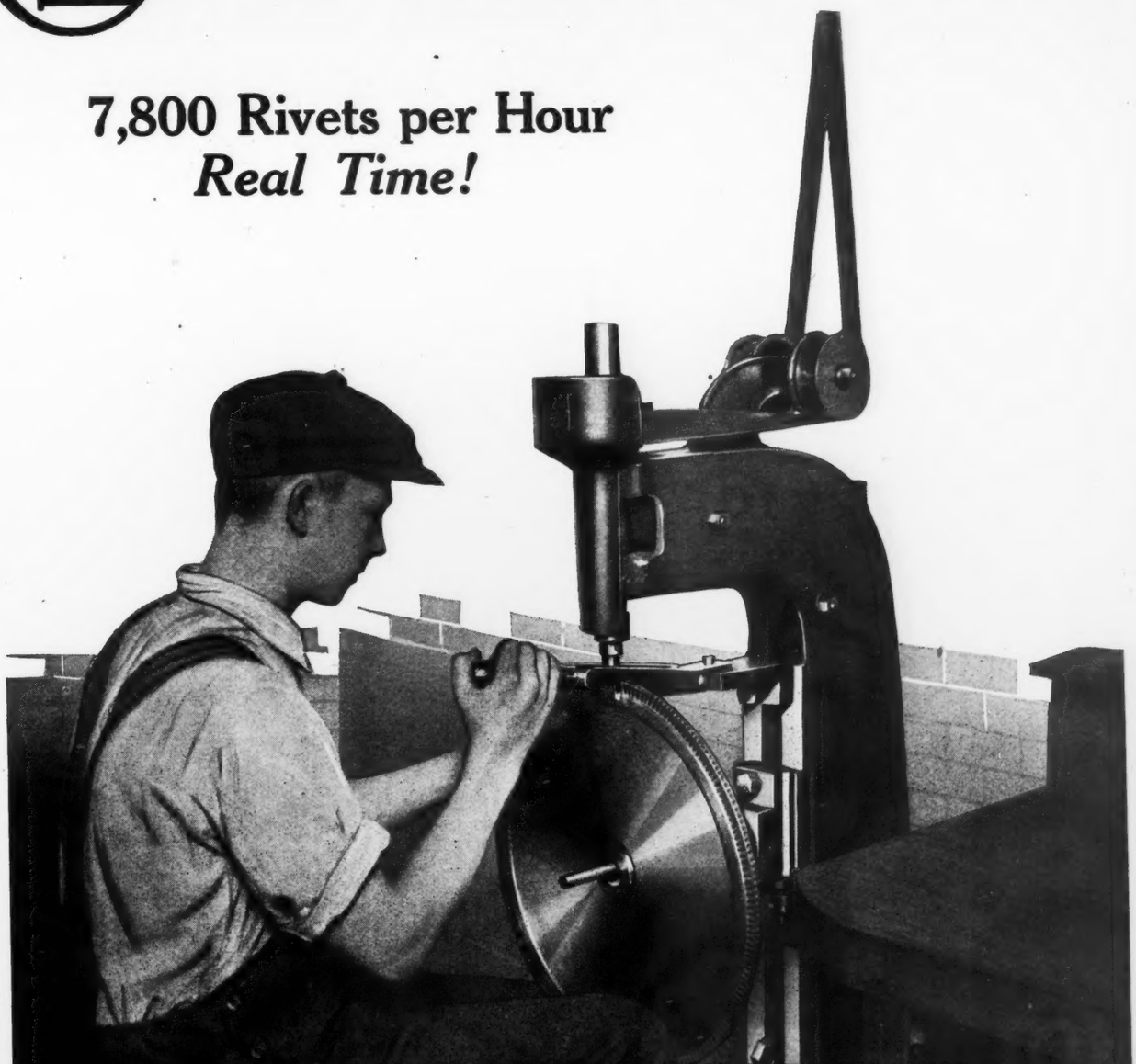
PAWLING & HARNISCHFEGER CO.

MILWAUKEE **Established 1884** **WISCONSIN**

50 Church Street, New York; 704 Stephen Gerard Building, Philadelphia; 926 Whitney Central Building, New Orleans, La.; 47 Fidelity Building, Pittsburgh, Pa.; 1241 Monadnock Block, Chicago, Ill.; Pittock Block, Portland, Ore.; 1125 Central Building, Los Angeles, 821 Monadnock Bldg., San Francisco.

GRANT RIVETING

7,800 Rivets per Hour
Real Time!



THIS Grant Riveter is working under almost ideal conditions of course, but even so, to the uninitiated the riveting speed must seem almost too good to be true.

The work on which this record is made is riveting Turbine Rotors at the Coppus Engineering Co., Worcester Plant. The Rotor comes to the operator assembled ready for riveting, all his time and attention are given to the actual operation.

Not only has the Grant Riveter sped this work from 520 rivets per hour (previous production by hand riveting), but the quality of the work has been greatly improved and manufacturing costs decreased.

Grant Rivets—tight and loose—insure durability and lasting satisfaction; Grant Riveters guarantee low manufacturing costs. Ask us about these machines.

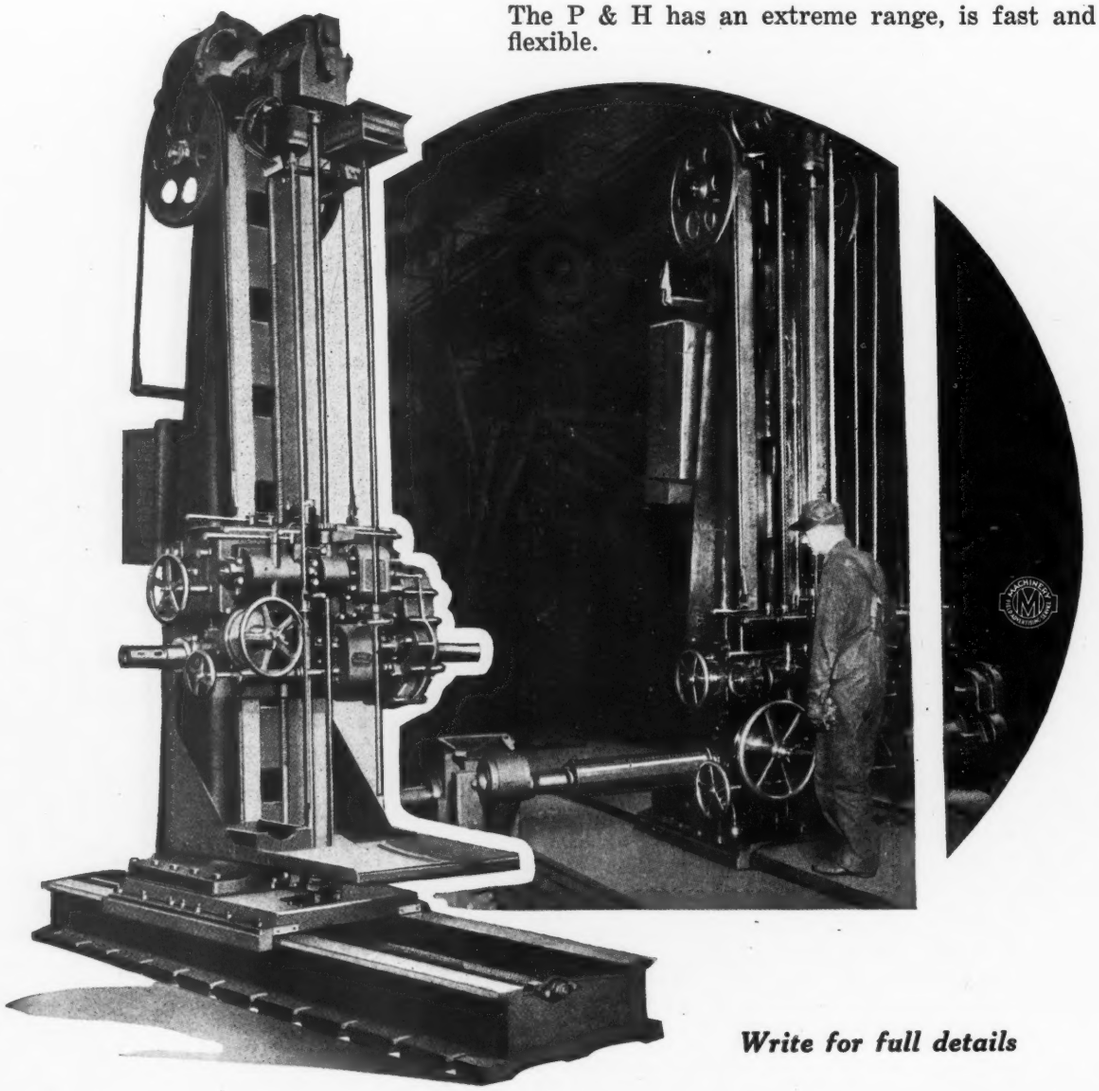
GRANT MFG. & MACHINE CO.
Bridgeport N.W. Station Conn.. U. S. A.

P & H Horizontal Boring and Drilling Machines

Higher Standards—Greater Speeds on Many Important Operations

"A most satisfactory machine for our purposes," says the superintendent of the Ingersoll Milling Machine Co., Rockford, Ill. Remember that more than usual demands on equipment are made in this plant, and that no machine is kept if it doesn't pass every test. The P & H, however, filled the bill in every particular. Here it is boring a quill bearing for the saddle of an Ingersoll Milling Machine. Hole is 5¾" diameter, 19" long. The work is within 5 minutes of completion, and the man had been on it 1½ hours.

The P & H has an extreme range, is fast and very flexible.

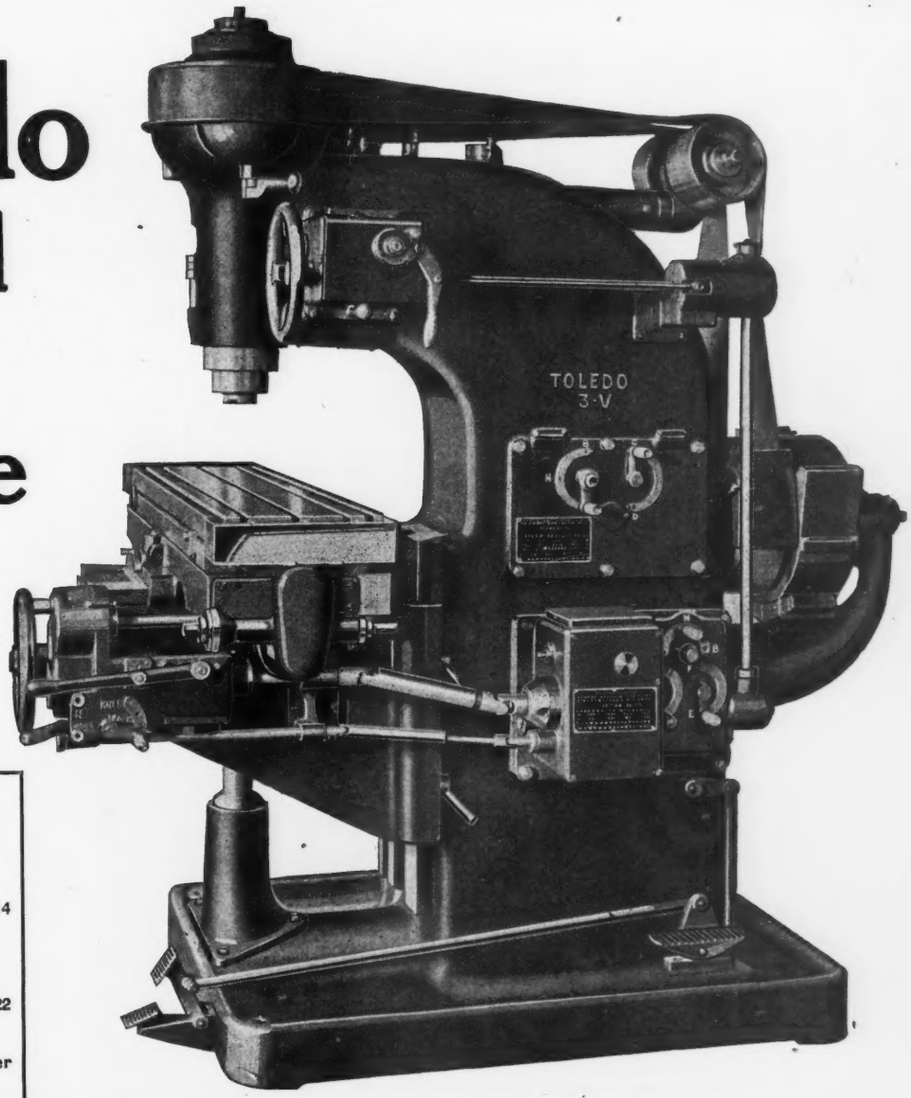


Write for full details

DALE-BREWSTER MACHINERY CO., Inc.

543 W. Washington Blvd., Chicago 56 Lafayette St., New York

Toledo Vertical Milling Machine



Specifications:

RANGE
Longitudinal Feed *46 inches.
Cross Feed *14 inches.
Vertical Adjustment (Knee) *14 inches.
Spindle Adjustment *6½ inches.
*Power Feeds.
Max. Throat Distance 19 inches.
Max. Distance Spindle to Table 22 inches.
Net Weight 7000 lbs.
Sixteen Feeds .004 to .710 per revolution of spindle.
Sixteen Speeds 18 to 411 R.P.M.

GET TOLEDO MILLING FACTS
DON'T TAKE ANYTHING FOR GRANTED

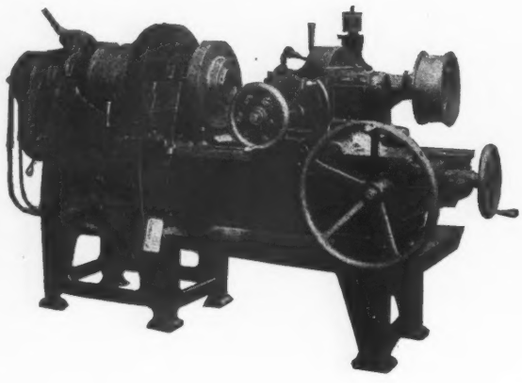
There is an old man up in Michigan who wound his clock every night for twelve years before he found out it was an eight-day clock. That old man is the type who takes things for granted—and fails to investigate.

Is that the way you buy milling equipment? Do you take it for granted that your present installation is the best the market offers, or do you know all about the Toledo Vertical Milling Machine?

If you don't know the Toledo Vertical Milling Machine then you owe it to yourself and your business to get first-hand information on what it will do in boosting your production, cutting manufacturing costs and reducing overhead. The marked improvements in the new Toledo Vertical Miller are the result of years of engineering research and achievement, and of a careful study of the user's practical needs.
There are numerous other reasons why—write for them.

THE TOLEDO MILLING MACHINE COMPANY
TOLEDO OHIO, U. S. A

SMALLEY-GENERAL PERFORMANCES



Interchangeable Threads Costing Too Much?

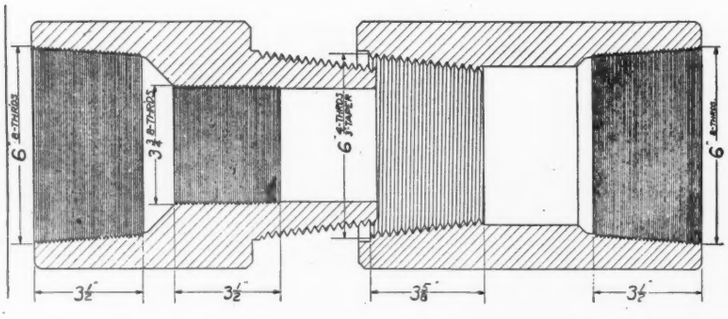
The Smalley-General Thread Miller

Will Help You Out As It Has Many Others

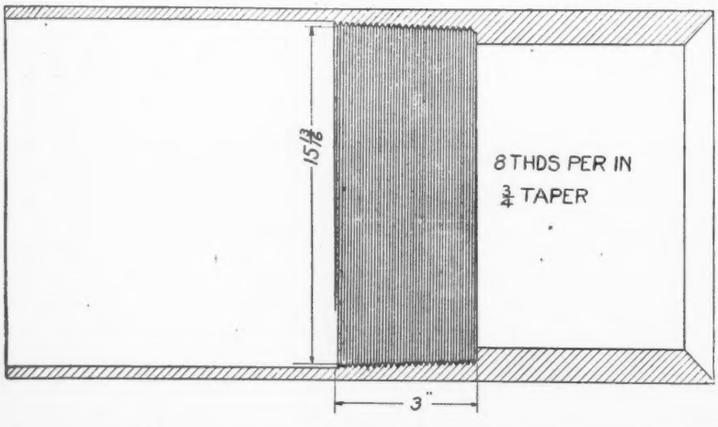
For Example—

The pin and box, of which a sketch is here shown was threaded in a lathe in an hour and a half. On a Smalley-General Thread-miller furnished with a suitable hob floor-to-floor time on each piece dropped to six minutes. Material is .20 Carbon Steel; thread is 3¾″ diam., 4″ long, 6-pitch U. S. S., with 3″ taper per foot. Milling speed is 4½″ per minute and a hand-operated screw chuck is used.

If it were desired to face the surfaces where pin and box come together true with the thread to provide the proper spacing for the feeler, the suitable speed could be instantly obtained.



The drive-shoe detailed below furnishes another typical Smalley-General triumph. The thread is 16¼″ diameter, 3″ long, 8-pitch Briggs Standard taper. Material is .55 Carbon steel, an air collet chuck is used and a 7″ milling feed. Seven minutes floor-to-floor completes this operation which took 36 minutes on the lathe.



Smalley-General Thread Millers

Mill internal or external, right- or left-hand, straight or tapered threads in quantity, with unparalleled speed and economy.

Smalley-General Thread Millers will be sold only with the approval of our Engineering Department. A guaranteed production estimate will be furnished with each machine. In case a machine should fail to perform and produce according to our guarantee, the purchaser will have the unquestioned right to cancel the sale.

SMALLEY-GENERAL COMPANY, Inc.

SMALLEY PLACE BAY CITY, MICH.

This Woodward & Powell Planer

Is Roughing and Finishing Machine Beds at an Average of One per Hour

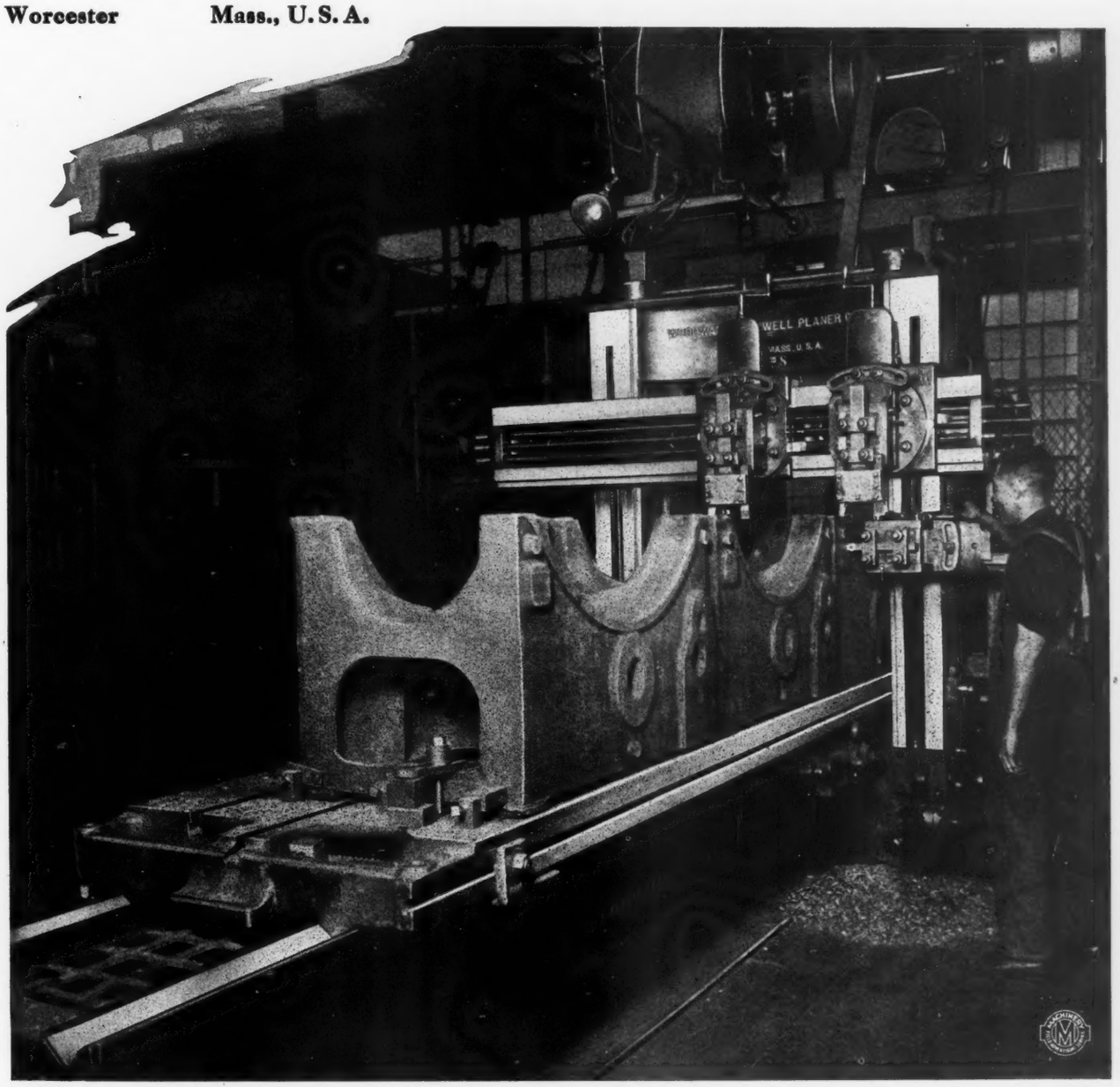
The Gleason Works, of Rochester, New York—builders of powerful, accurate machines—use this big Woodward & Powell for heavy planing of all descriptions.

The photograph shows it roughing and finishing beds for bevel gear planers—three heads and five tools working simultaneously finish an average of three beds in three hours without taxing the machine. Accurate work, careful construction, easy accessibility of all working parts and quick, smooth, convenient operation make Woodward & Powell Planers popular in all shops where quality *plus* production is the rule.

WOODWARD & POWELL PLANER COMPANY

Worcester Mass., U. S. A.

Standard and Heavy Types
Belt or Motor Drive



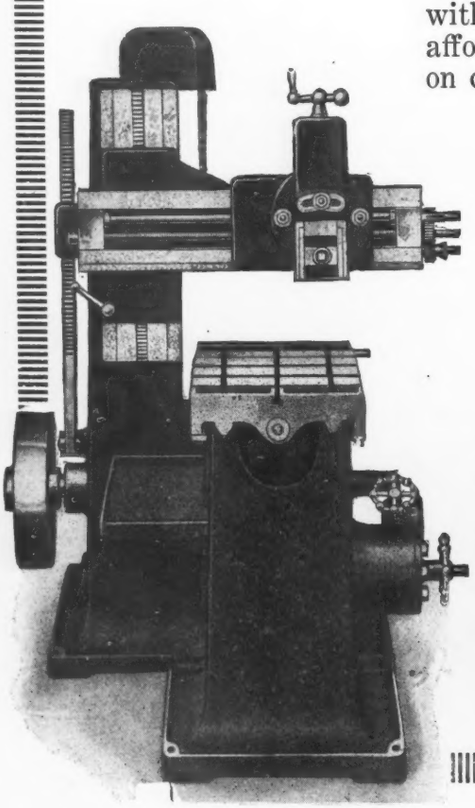
A Machine You'll Want to Own

The Coulter Tool Room Open Side Planer

Like the handyman of the "good old days," the Coulter Toolroom Planer accomplishes a wide variety of odd jobs which standard toolroom equipment lacks the power, speed or capacity to handle to advantage—bridges the gap between shaper and planer and fills an important and well-recognized need in the modern toolroom.

Combining the accuracy of the planer with the speed and convenience of the shaper, this machine has sliding gears equipped with S. K. F. Ball Bearings, easily shifted to provide four speeds of table for each length of stroke—a suitable speed for every class of work and metal, from fine steel dies to heavy brass fittings.

The advantages of the open side are obvious, also the convenience of the large, carefully gibbed table, equipped with three tee-slots and the rigidity afforded by the ample sliding surfaces on cross rail and column.



Material is of the best throughout and workmanship such as to place it unreservedly in the toolroom class. Principal dimensions include Table, 46½" by 17½"; center to center of ways, 11"; length of saddle on cross-rail, 14"; diameter of swivel head, 10"; height from table to floor, 36"; cross rail traverse, 20"; table traverse, 24". Complete description in circular—sent on request.

THE AUTOMATIC MACHINE COMPANY

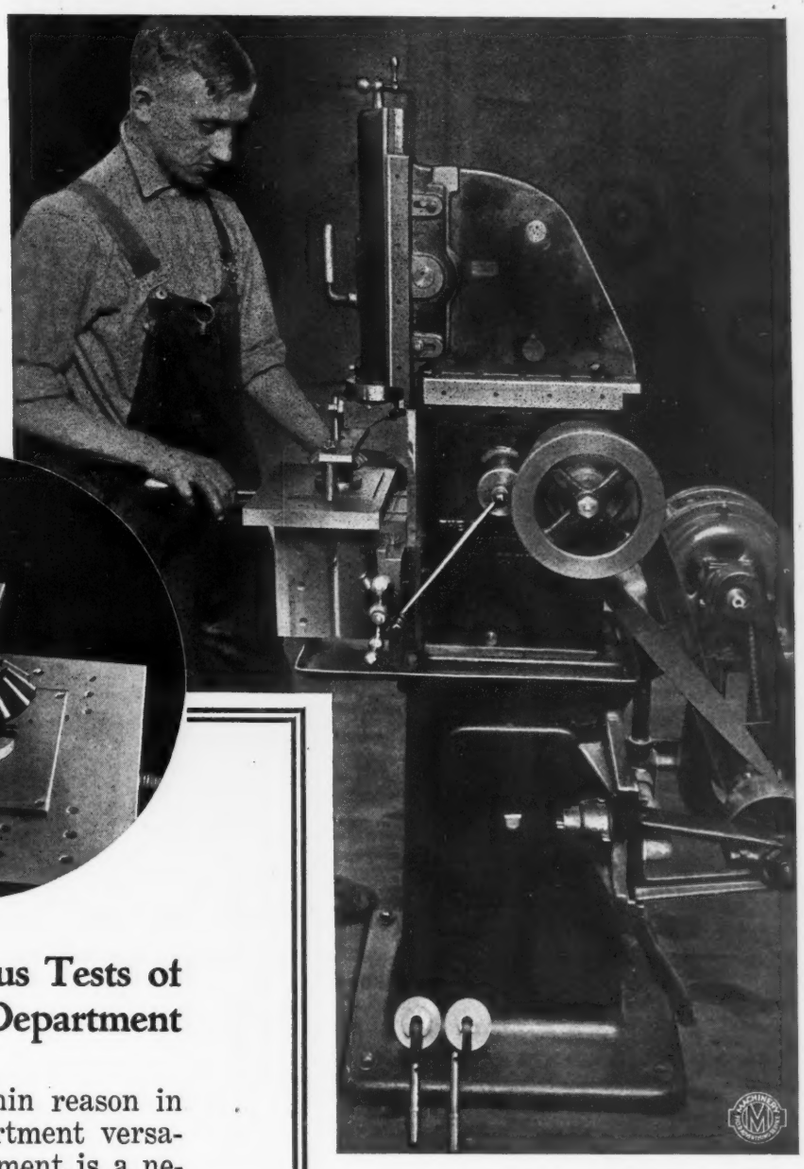
BRIDGEPORT CONN., U. S. A.

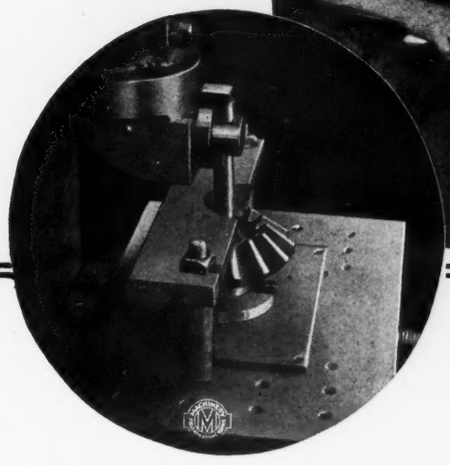
OVER-SEAS REPRESENTATIVE

ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA
51 CHAMBERS ST. NEW YORK, U.S.A.

PARIS TURIN ZURICH BARCELONA

The RHODES COMBINED SHAPER AND SLOTTER





Passes the Strenuous Tests of the Experimental Department

For keeping costs within reason in the experimental department versatile machine tool equipment is a necessity. And this is where the Rhodes combined Shaper and Slotter fits. It has a wide field of usefulness, being equally efficient in both vertical and horizontal planes. It comes equipped with a rotary table and vise.

Used in the plant of the Sampson Tractor Company, Janesville, Wisconsin, for numerous keyseating, slotting and light shaping jobs, this "Rhodes" is always busy, and the foreman of the experimental department is more than pleased with the performance.

Photograph shows the "Rhodes" cutting a 1/4" x 3/32" keyway in a grey iron mitre pinion for a corn picker. This pinion is 1" face, and is bored to 7/8" through a hub 2" in depth.

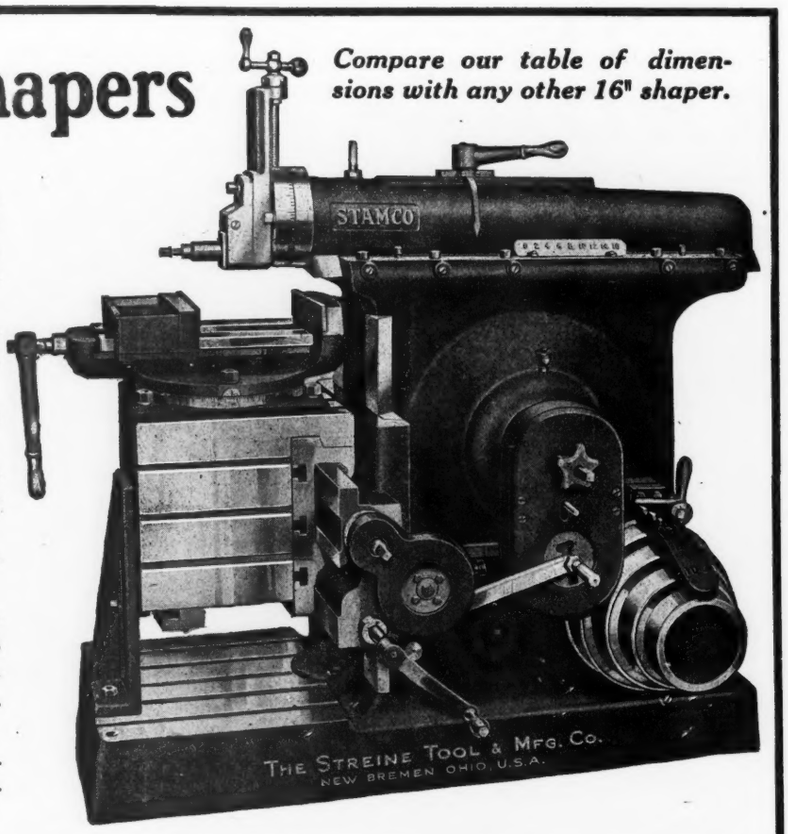
The Rhodes Combined Shaper and Slotter operates in two planes: horizontal and vertical. It is either a 7" shaper or a 3½" slotter at will. The "Rhodes" is two machines in one at the price of one. Write for full particulars.

The Rhodes Mfg. Co.
Hartford Dept. 101 Connecticut

Stamco Shapers

Compare our table of dimensions with any other 16" shaper.

Base is of extended type.
Column of extra depth and width having lower center of gravity.
Bull Gear Bearing is cast solid in frame having bearing surface of 205 square inches.
Bull Pinion and Intermediate Gears are assembled in unit same as in planer construction.
Machine Pulley rotates in sleeve bearing.
Rail is fastened to dovetailed slide same as in milling machine construction.
Ram is extra long and also has a dovetailed slide.
Saddle designed with narrow guide.
Table is hooked over saddle thus relieving table bolts of thrust.
Table Elevating Screw is of Telescopic construction.
Feed can be varied or reversed instantly without stopping machine.

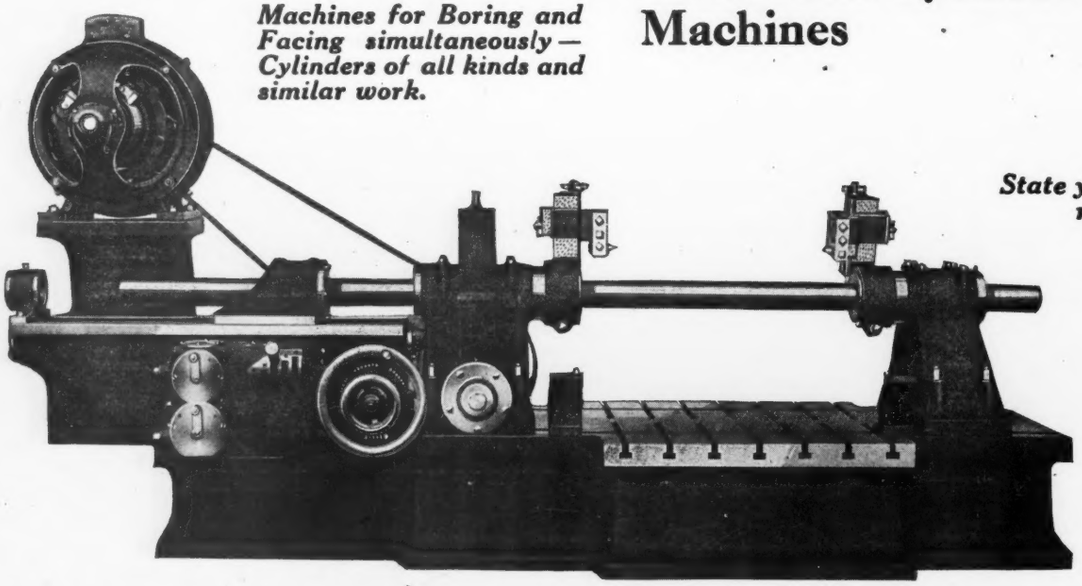


THE STREINE TOOL & MFG. CO., New Bremen, Ohio

Barrett

For Thirty-Eight Years—Builders of "BARRETT" Horizontal Cylinder Boring Machines

Machines for Boring and Facing simultaneously—Cylinders of all kinds and similar work.



State your requirements

BARRETT MACHINE TOOL CO., Meadville, Pa., U. S. A.

Automatic Screw Driving

With a Reynolds Magazine-fed Machine Saves Time and Labor

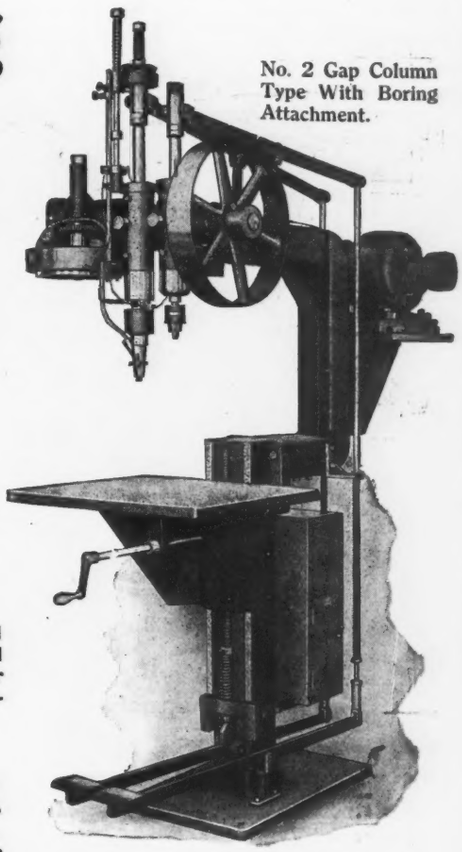


In one-third the time it takes your most experienced hand worker to accomplish the same task, an unskilled boy can drive screws or bolts of any three consecutive sizes accurately to any desired depth with the Reynolds Screw Driving Machine, and produce a more ship-shape and accurate job into the bargain.

Screws are dumped loose into a hopper and sorted and fed automatically. Release is by foot-lever which leaves the operator's hands free to position the work and an average of 800 to 1,200—sometimes 2,000—screws per hour is readily obtained.

This machine is indispensable where screws or bolts are set in large quantities. It increases output and lowers assembling costs to a degree well worth investigating.

Give us dimensions over all of your work and gauges and lengths of screws or bolts used, and we'll recommend the "Reynolds" best adapted for the job and furnish details and estimated production.



No. 2 Gap Column Type With Boring Attachment.

THE REYNOLDS MACHINE CO.

MASSILLON Dept. M OHIO, U. S. A.

BENCH MILLING MACHINE



For Small Work in Large Quantities

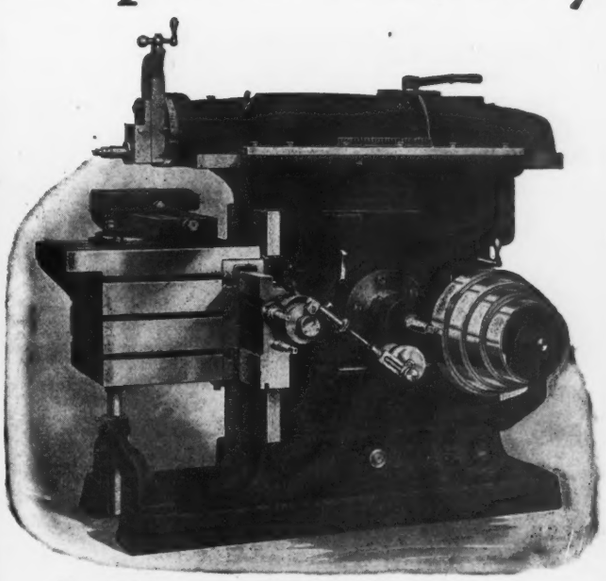
This machine is built with the same care as our larger millers; it is accurate and right in every particular; highly profitable on a wide variety of small work. Can be had with floor column if desired. Ask for complete description.

THE CARTER & HAKES COMPANY

Sterling Place WINSTED, CONNECTICUT

WE CONFINE OURSELVES TO BUILDING

Shapers Exclusively

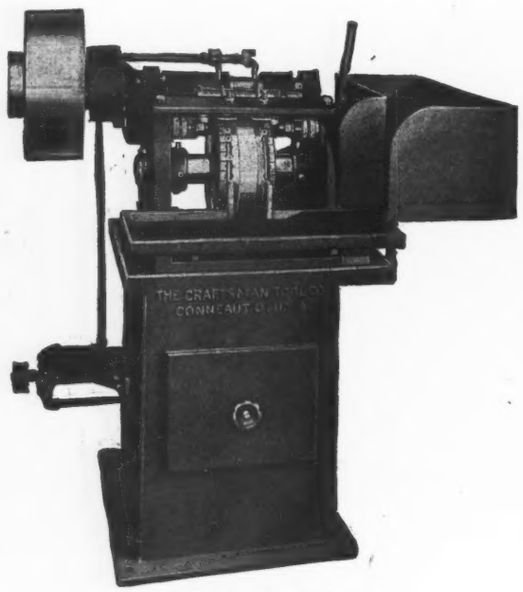


Crank Sizes: 12, 14, 16, 20, 25, 28 and 32 inch
Either Cone Driven or through Speed Box

The Smith & Mills Company

CINCINNATI OHIO, U. S. A.

FOREIGN AGENTS: G. & F. Limbourg Freres, Brussels, Belgium; Burton, Griffiths & Co., Ltd., London, England; Van Rietschoten & Houwens, Rotterdam, Holland; Reid Brothers (Johannesburg) Ltd., Johannesburg, South Africa; J. Lambercier & Co., Geneva, Switzerland; Zurich, Switzerland; V. Lowener, Copenhagen, Denmark; Christiania, Norway; Stockholm, Sweden; H. P. Gregory & Co., Sydney, N. S. W., Rene Berndes Co., Havana, Cuba; Horne Company, Ltd., Tokyo, Japan; Daniele Stussi, Milan, Italy.



Craftsman Rotary Miller No. 2

Send parts or prints for production estimates

CRAFTSMAN
Continuous Rotary Miller

It Cuts Slots on Small Parts

What are you manufacturing? Make a mental picture of its parts—any small slotting? How do you do it?

And now consider the Craftsman Continuous Rotary Miller. It cuts slots on nuts and other small parts in bulk.

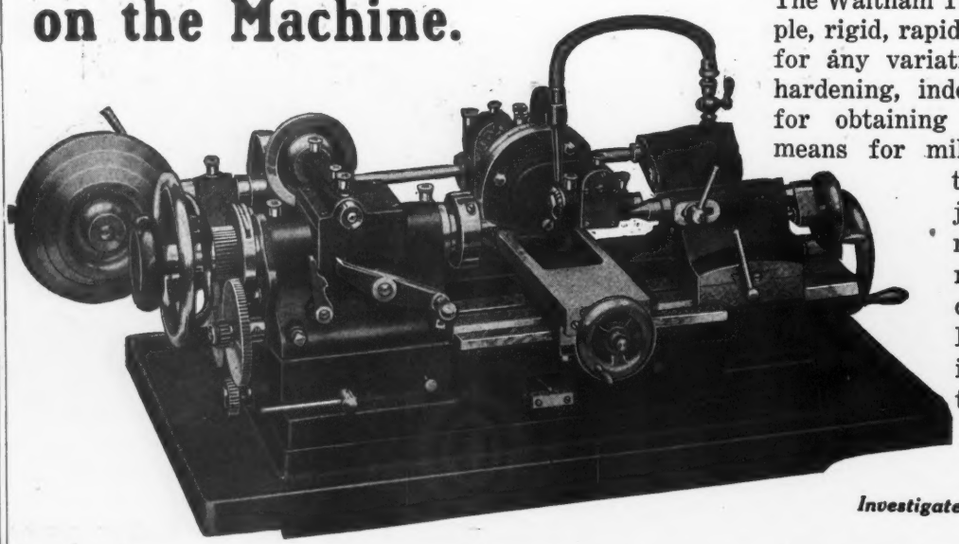
Revolving chuck consisting of three steel plates can be adapted to hold a wide range of styles and sizes of parts. Look into this proposition—do it now.

THE CRAFTSMAN TOOL COMPANY

CONNEAUT OHIO, U. S. A.

The Milled Thread Leads for Quality. Its Cost Depends on the Machine.

One of the most dependable and economical thread millers in use is the reliable "Waltham," designed and constructed to handle the finest class of work—standard and special taps, thread gauges, etc.



The Waltham Thread Miller is simple, rigid, rapid; has compensation for any variation of the lead in hardening, index of 12 divisions for obtaining multiple threads, means for milling square sided threads and for adjusting cutter to match threads already cut. Can be operated in battery. Ideal manufacturing, experimental or tool-room machine.

Investigate Waltham Advantages

WALTHAM MACHINE WORKS, - Newton Street, Waltham, Mass.

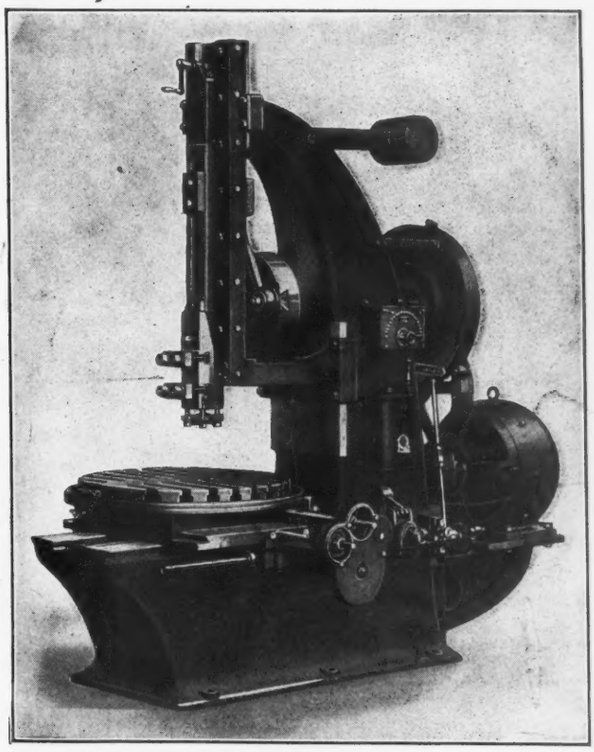
Small Thread Millers, Gear Cutters and other Small Automatic Machines

William Sellers & Co., Incorp. Philadelphia, Pa.

LABOR SAVING MACHINE TOOLS

Sellers Slotters

have automatic rotary, cross and longitudinal feeds, also easy hand adjustment. Bearing for slotting bar is adjustable to suit height of work, and may be brought down close to table, affording firm backing to tool. All sizes have spring relief tool apron. They are easy to handle, and the grouping of operating levers and controlling apparatus affords the greatest convenience of manipulation, thus securing maximum output. The construction and workmanship insure accurate product and durability.



SHAFTING, INJECTORS
DRILL AND TOOL GRINDERS

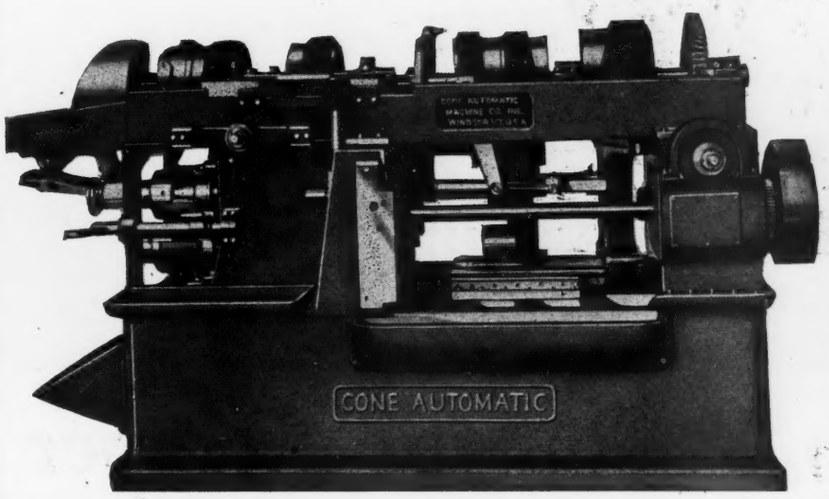
Output and Cost Tell the Story of this Machine

The Cone Four Spindle Automatic

The outstanding points in which this machine differs from others make it a notably rapid, economical producer of screw machine parts up to 3½" x 7". Box type, double bed construction provides for the cam shaft to be carried by the upper bed, and the machine spindles and tool slides by the lower. All movements are obtained by flat cams bent to fit cam drums, independently adjusted, which permits increased production by tooling in duplicate. Control is arranged with unusual consideration for operating convenience. Finished work is at all times in plain sight, and there is a special arrangement for automatically deflecting the work and removing the chips without interfering with the operator.

Spindles are of hardened steel and run in phosphor bronze bearings, main drive shaft is hardened and ground and equipped with Hyatt Roller Bearings.

Details and production records on request.

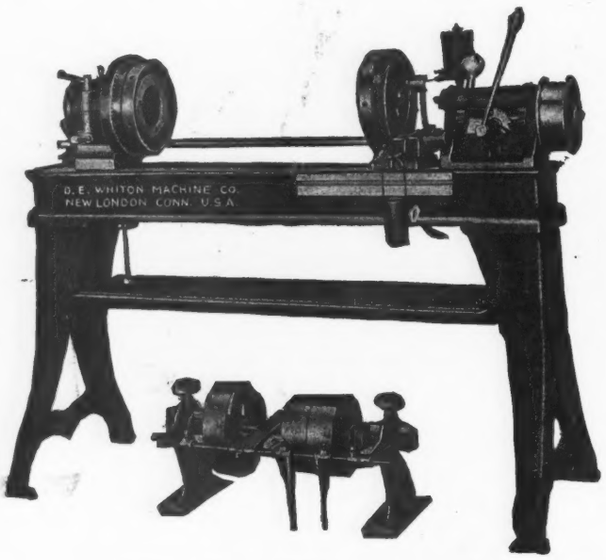


Cone Automatic Machine Co., Inc.

Windsor Vermont, U.S.A.

Agent for Michigan Territory:
J. C. Austerberry, 65 Shelby St., Detroit, Michigan.

THE WHITON
Revolving Centering Machine



For Accurately Centering Finished Shafts

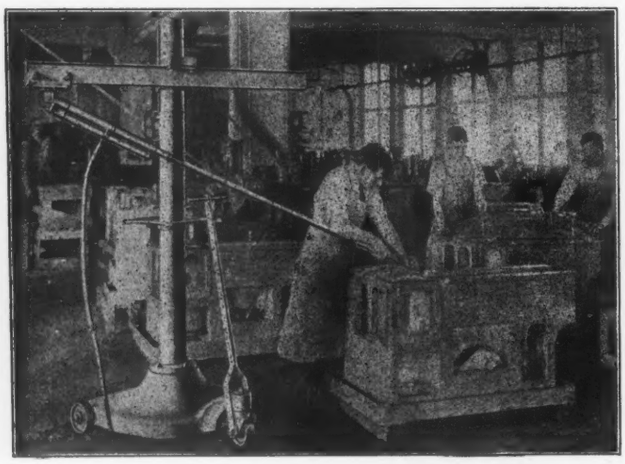
The cut shows new **Revolving Centering Machine**—a large size of the well-known machine of this type. It is heavier throughout and has capacity to center shafts up to 5 inches in diameter.

Constructed same as the smaller machine and embodies all the special features.

Circulars and prices sent upon application.

The D. E. WHITON MACHINE CO.
NEW LONDON, CONNECTICUT, U. S. A.

Increase Production Without Touching the Payroll



Let us send you booklet "Doing It With Air." Write

Install the Anderson Pneumatic Scraper

The above heading is nothing more nor less than a simple statement of fact. When you install the Anderson Pneumatic Scraper you can either put your men on work other than scraping, getting the same results as you do now, or you can do considerably more scraping. The Anderson Pneumatic Scraper supplies the power, that's all. The men lose none of their skill.

THE ANDERSON BROS. MANUFACTURING CO.
1910 Kishwaukee St. ROCKFORD, ILL.

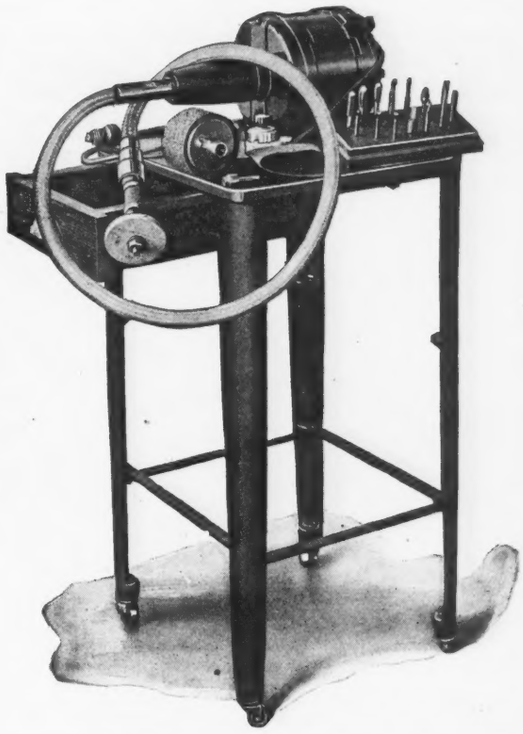
Anderson Pneumatic Scraper

Of Interest to Die Makers, Pattern Makers, et al.

A compact, portable Grinding and Scraping Outfit which recommends itself to busy workmen because of its durable construction and practical, and convenient range of equipment.

It consists of ½ H. P. bench type motor with cone connection and a 7/16″ sheathed shaft, a ball bearing hand piece, 5″ emery wheel, complete assortment of emery burrs in a neat wooden box, and a sanding drum abundantly supplied with emery bands.

Motor is mounted on a base and equipped with snap switch and cord. Table is furnished extra at a nominal price.

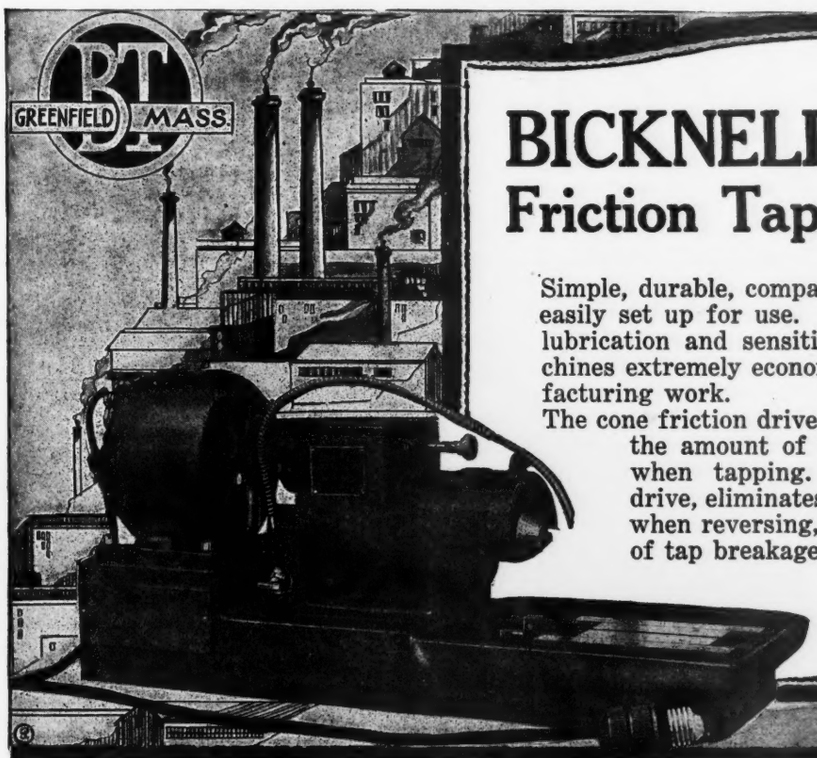


Complete description and quotations on request

THE HERGI MFG. CO., 250 Fifth St. **BRIDGEPORT, CONN.**

Manufacturers of Portable Electric Tools

Foreign Representatives: GOODCHILD & PARTNERS, Ltd., London, England; ATLANTIC-BALTIC CO., Ltd., Copenhagen, Denmark



BICKNELL-THOMAS
Friction Tapping Machines

Simple, durable, compact—completely equipped and easily set up for use. Careful construction, ample lubrication and sensitive controls make these machines extremely economical for use in small manufacturing work.

The cone friction drive is automatically adjusted by the amount of pressure put on the spindle when tapping. This insures a sensitive drive, eliminates the sudden strain on the tap when reversing, greatly reducing the danger of tap breakage.

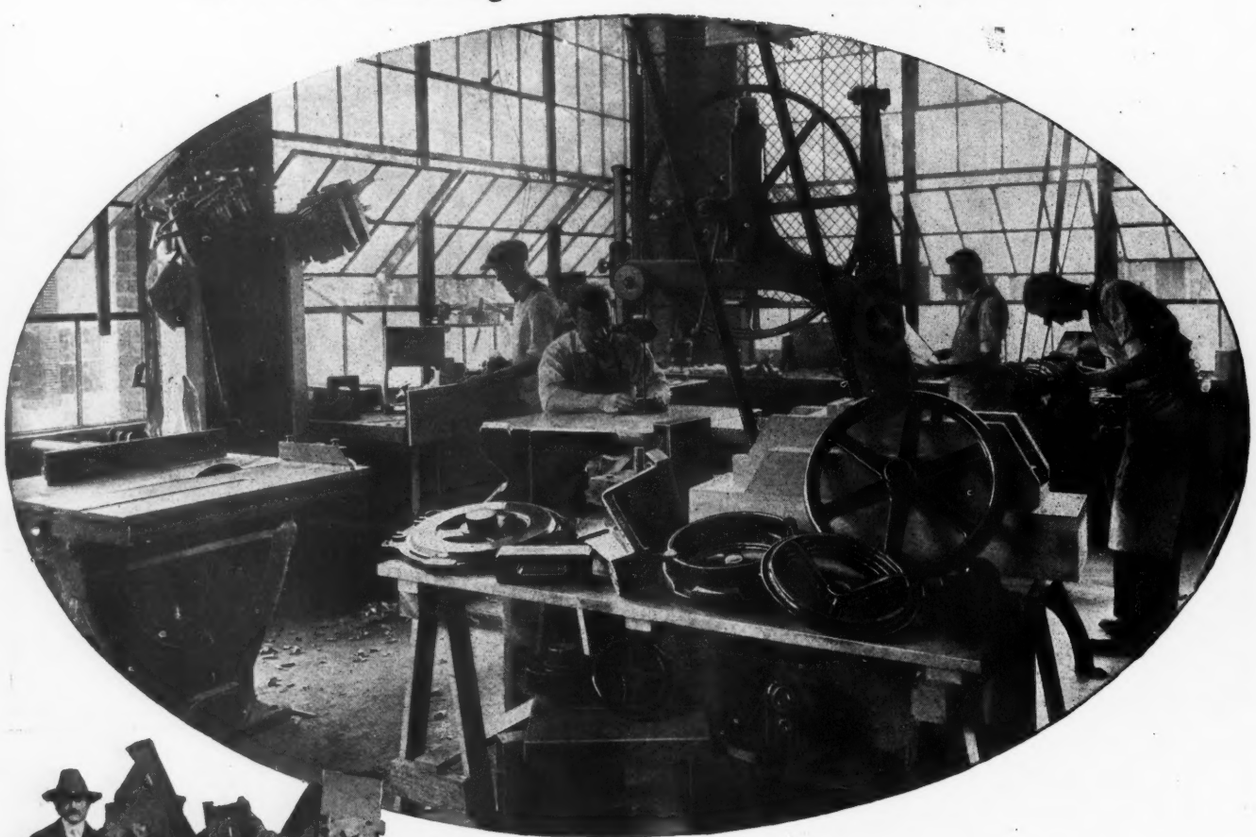
Capacity 0″ to ¼″ taps, size 23″, weight 65 pounds with motor. May we give you further details?

BICKNELL-THOMAS COMPANY, Greenfield, Mass.

CHICAGO REPRESENTATIVE: H. S. Huncke, 15 N. Jefferson St. PACIFIC COAST REPRESENTATIVES: The Chas. A. Dowd Sales Co., 320 Market St., San Francisco. FOREIGN AGENTS, CANADA: The Jas. Buckley Co., St. Nicholas Bldg., Montreal. ENGLAND: Goodchild and Partners, Ltd., London, W. C.

"Oliver" Wood Working Machines

In a Busy Pattern Room





The accompanying illustrations are published through the courtesy of the Mehl Machine Tool & Die Company, of Roselle, N. J., in whose pattern department they were taken.

The larger picture shows a complete installation of "Oliver" Wood Working Machines—in daily use for the past seven years in the pattern department of the Mehl Machine Tool & Die Company, which specializes in fine toolwork—jigs, fixtures, dies, gages and special machines. The small view represents part of one order recently delivered by this company and serves to show that its pattern requirements are no small item.

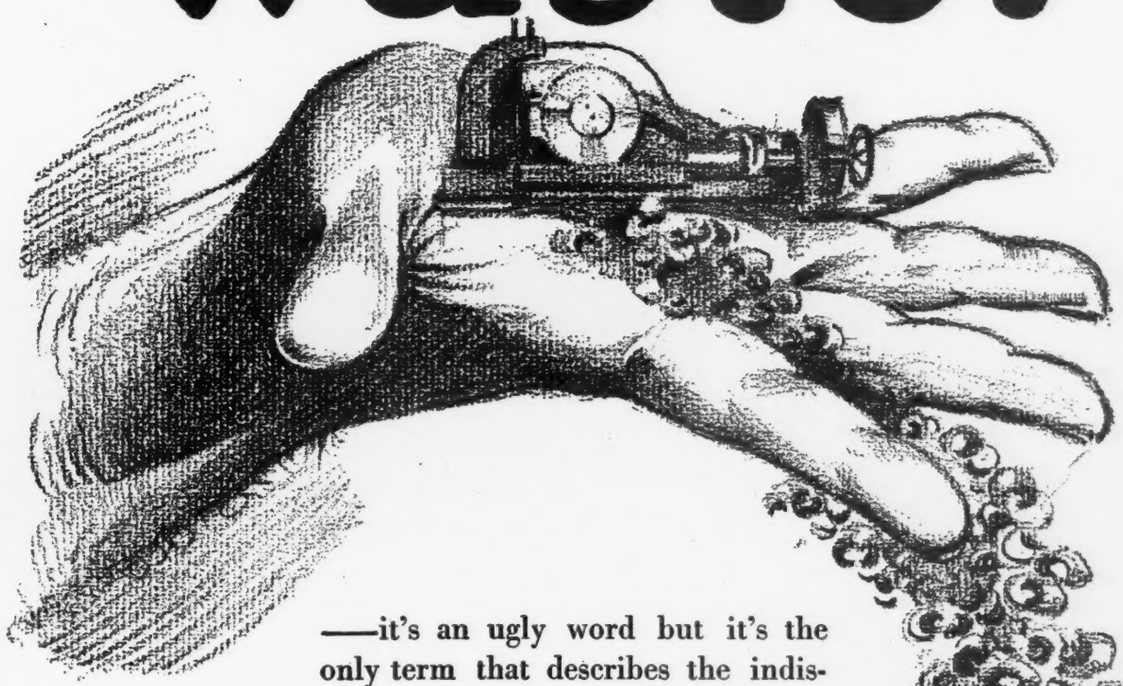
"Oliver" Machines have given "excellent satisfaction" in this shop and the proprietors not only have "no complaints to offer," but are very enthusiastic in recommending "Oliver" products.

"Oliver" Pattern Shop Machinery meets all up-to-date requirements. They are simple, well made machines of large scope and with many practical and exclusive advantages—serviceable machines with a reputation for maximum output and low maintenance cost.

Details of whole line on request.

OLIVER MACHINERY CO., Grand Rapids, Mich.

-waste!



——it's an ugly word but it's the only term that describes the indiscriminate use of rotary cutting-off saws with steel at present prices.

The heaviest Starrett Hack Saw made—a blade that does the work a half-inch rotary is often used for—is but .065 inch thick.

Compare its "kerf" with that of the rotary and the saving isn't hard to see.

If you're a hack saw user you need a copy of the Starrett Hack Saw Book. Sent free with Catalogue No. 21 D, upon request.

To get the most out of every box of Starrett Blades, you need the Starrett Hack Saw Chart D sent free on request.

THE L. S. STARRETT CO.

The World's Greatest Toolmakers
Mfrs. of Hack Saws Unexcelled

ATHOL, MASS.

STARRETT HACK SAWS CUT QUICKER LAST LONGER

STARRETT TOOLS

42-55

Starrett Hack Saws

"Cut" versus "Hack"

The difference between trying to chop off a two-days' growth with a pair of scissors and gliding over your face with a smooth, keen-edged razor:

The same principle applies to cutting metal. Which explains why a Napier Metal-Cutting Machine is now taking the place of two or three power hack machines in all large factories where metal cutting is done.

This change was necessitated during the War when speed and maximum production counted most.

It is necessitated now, when accuracy, finish and low metal-cutting costs figure prominently.

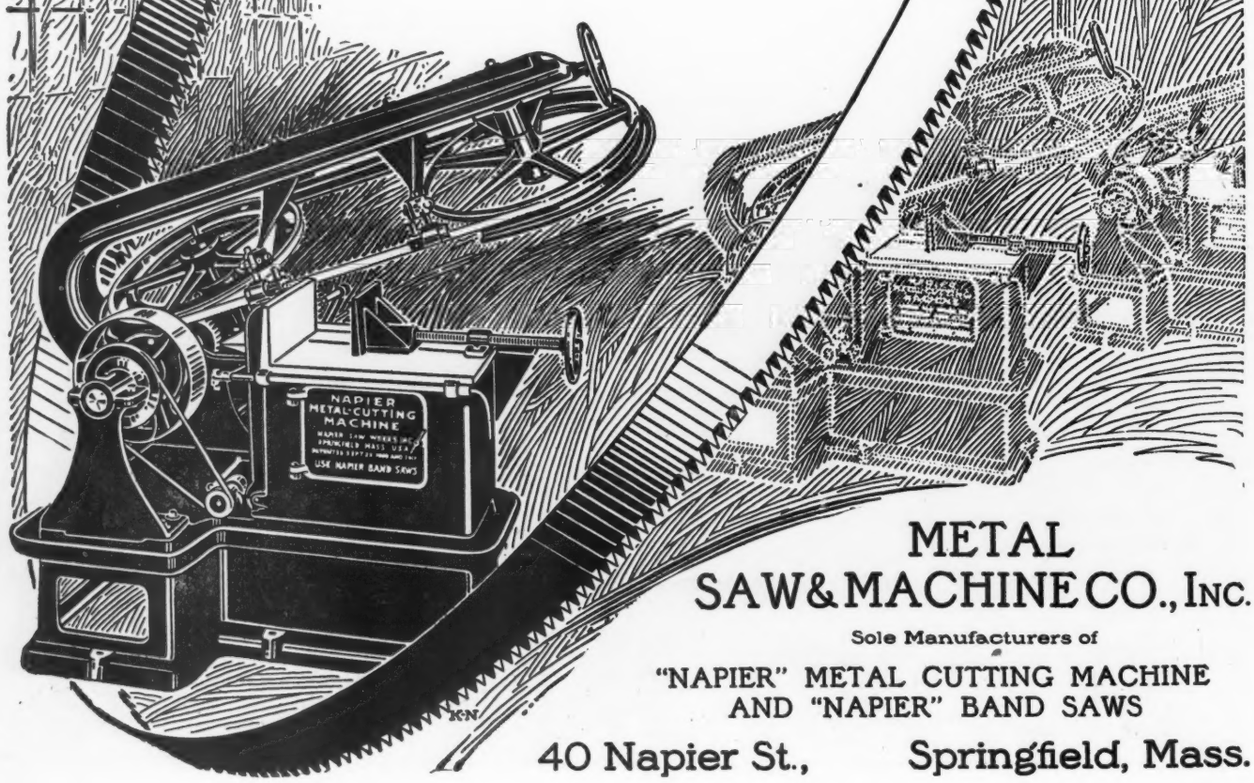
The Napier CUTS—with a continuous, one-way movement. There is no "hacking" back and forth. That is why it can use a thinner blade. A thinner blade means a big saving of metal.

This saving of pounds of steel per cut has caused many manufacturers to adopt the Napier Metal-Cutting Machine on this one count alone.

The Napier runs through the hardest tool steel, the softest machinery steel or cast iron, with equal ease. It always works smoothly, steadily and FAST. No vibration—no lost motion—no lost time.

The NAPIER Metal-Cutting Machine is built to "stand up." It is strong, rugged, enduring—a high-grade, dependable machine tool. Cuts any size up to 10 x 10 inches, round or square, and takes only 4 x 6 feet of factory room. Belt or motor-driven. Weight, 1550 pounds.

Descriptive Booklet Gladly Sent Upon Request

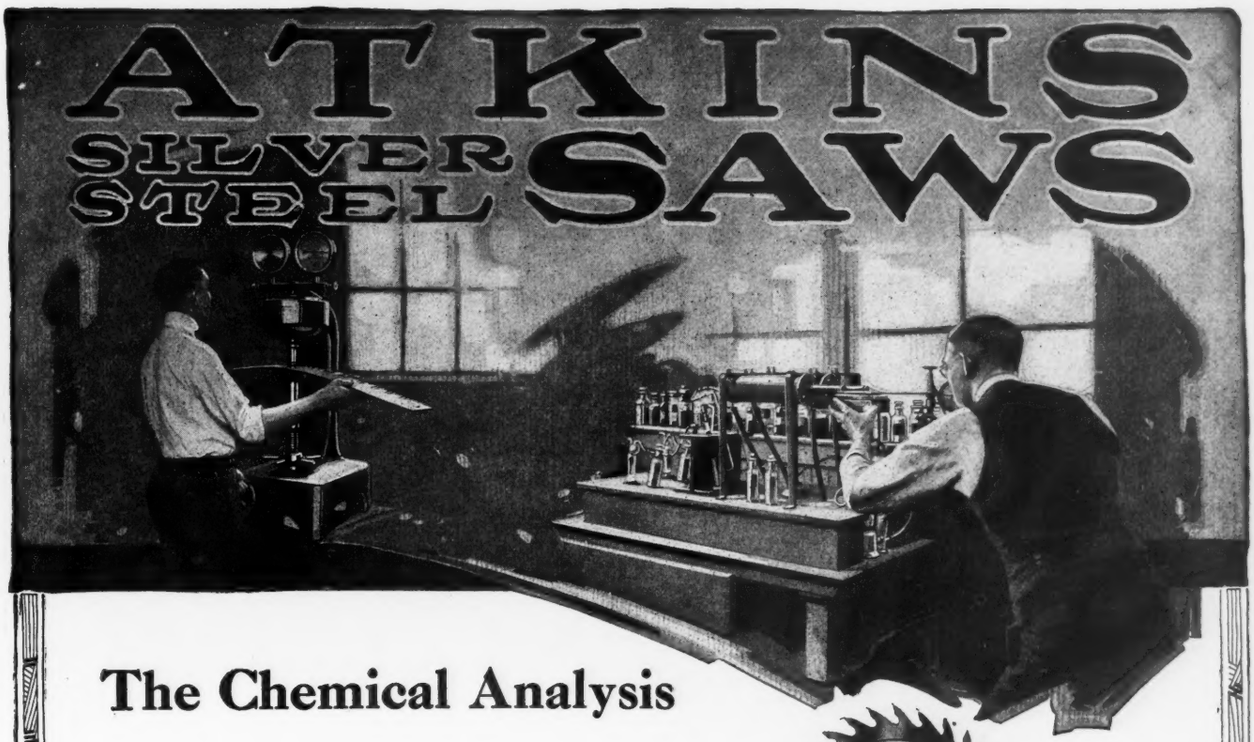


METAL
SAW & MACHINE CO., INC.

Sole Manufacturers of

"NAPIER" METAL CUTTING MACHINE
AND "NAPIER" BAND SAWS

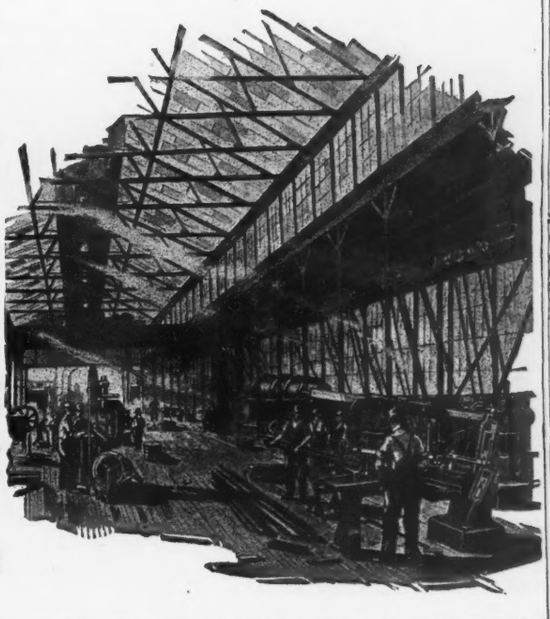
40 Napier St., Springfield, Mass.



The Chemical Analysis

In the making of crucible steel it sometimes happens that there is what are known as "off ingots"—the mixture not being correct. However, with our modern laboratory equipment we have the facilities for detecting any variation from the Atkins standard for "Silver Steel." We subject each plate to minute chemical analysis and physical inspection.

Our metallurgists know what constitutes the "Silver Steel" formula, and there is no deviation from it, hence you can depend upon Atkins Saws, because they are uniform in quality and efficient to the highest degree.



Ask for latest catalog.

E. C. ATKINS & CO., Inc.

Established 1857 *"The Silver Steel Saw People"*

Home Office and Factory: INDIANAPOLIS, IND.

Canadian Factory: HAMILTON, ONTARIO

Machine Knife Factory: LANCASTER, N. Y.

Branches carrying complete stocks in the following cities:

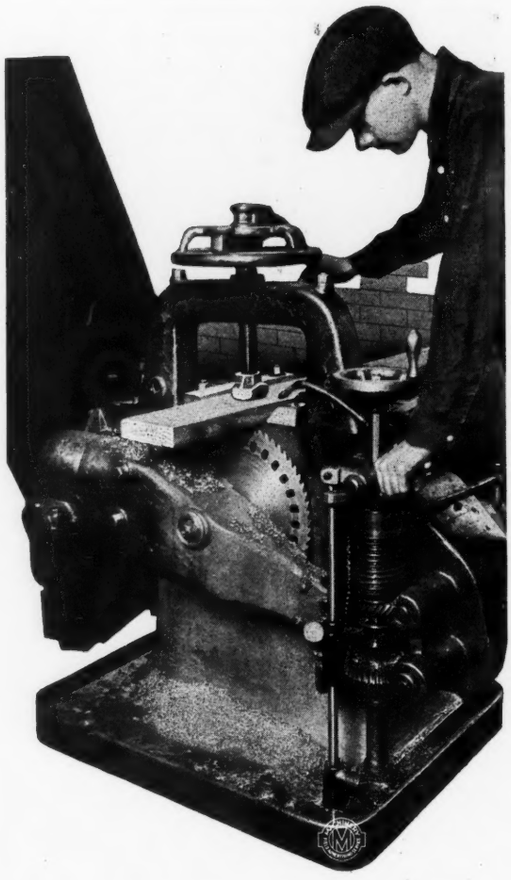
Atlanta	Minneapolis	Portland, Ore.	Paris, France
Chicago	New Orleans	San Francisco	Sydney, N. S. W.
Memphis	New York City	Seattle	Vancouver, B. C

LEA-SIMPLEX Cold Saws

Insure Maximum Production

The working principle is original and practical, cutting action easy and powerful, and construction simple—all of which insure economical operation and a high rate of production with minimum wear on the saw blade.

This photograph—taken at the J. H. Williams Company's Buffalo plant—shows clearly how the upward cut of the saw permits the chips to fall away without clogging the work—a feature that helps insure maximum service between grinds.



The details are interesting—may we send them?

Made by Earle Gear & Machine Company, Philadelphia

Distributed Exclusively By

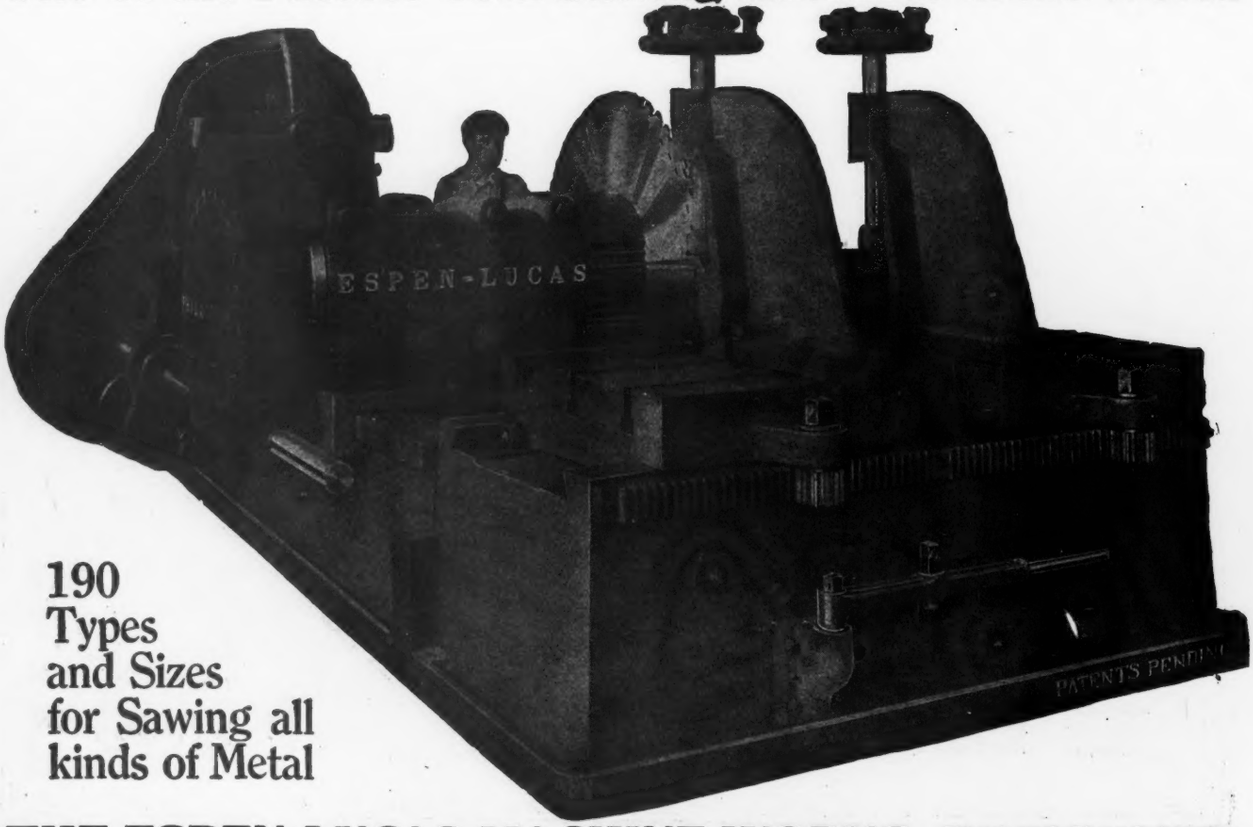
The FAIRBANKS Company

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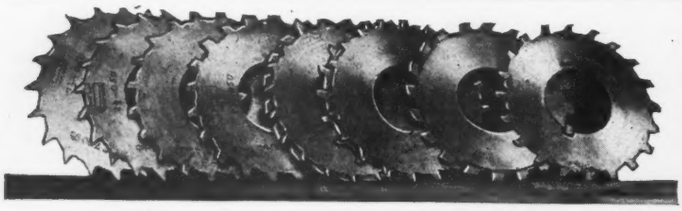
One of the Fastest Cold Sawing Machines in the World



190 Types and Sizes for Sawing all kinds of Metal

THE ESPEN-LUCAS MACHINE WORKS, Front and Girard Avenues **PHILADELPHIA, PA.**


Sterling
Hack Saw Blades
Twenty years of service have so built up the reputation of Sterling Hack Saw Blades that our greatest business asset is the goodwill of our many patrons.
This goodwill it has been our constant endeavor to sustain, so that in specifying "Sterling" the purchaser of hack saw blades, wherever he buys them, is assured of the utmost from his investment.
Sterling Hack Saw Blades, Frames and Machines. Ask for them everywhere
DIAMOND SAW & STAMPING WORKS
357-361 Seventh Street
BUFFALO
N. Y., U. S. A.
MACHINERY



"Twice as Fast as a Cutter Grinder"

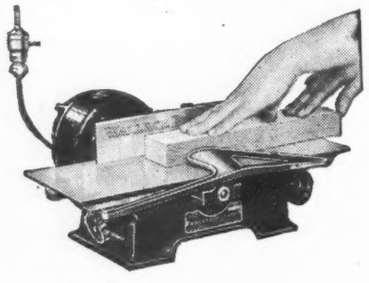
The No. 10 Automatic Saw Sharpening Machine

This machine has made an important place for itself in the cutter grinder department of the Remy Electric Co., at Anderson, Ill. Here it not only keeps seven or eight sizes of slitting saws in condition, but also does a variety of special work impossible to handle on any other cutter grinding machine.

It works twice as fast as the average cutter grinder, and its automatic indexing feature leaves the operator free to attend other machines. We shall be glad to tell you more about it.



MACHINERY COMPANY OF AMERICA
BIG RAPIDS **MICHIGAN, U. S. A.**
Pacific Coast Office: 304 First Ave., So. Seattle, Wash.



Save the Wasted Steps!

Take the machine to the job instead of wasting time taking the job to machines.

Do the work at the bench on WALLACE Bench Planers, Jointers and Saws —saves hand work also.

J. D. Wallace & Company
1421 W. Jackson Blvd. **Chicago, Ill.**

The
HIGLEY
COLD METAL SAW
Catalog furnished by
Vandyck Churchill Co.
New York **Philadelphia** **New Haven**

BARNES
SAWS FOR METAL
BAND MANUFACTURED BY **HACK**
DETROIT **W.O.BARNES CO.** MICHIGAN

PITTSBURGH SIMPLEX SAWS
Have Correctly Designed Teeth
STRONG—SIMPLE—TIME-SAVING—TROUBLE PROOF
The Pittsburgh Saw & Manufacturing Co.
Pittsburgh **Penna., U. S. A.**

GOODELL-PRATT
1500 GOOD TOOLS



Hack-Saw Blades

IT is on the job that Goodell-Pratt Hack-Saw Blades prove their true worth. Thousands of mechanics know how well they stand the grind of severe work day in and day out. This is because Goodell-Pratt Hack-Saw Blades are made to meet actual working conditions — not to pass freak tests.

Only the finest hot-rolled tool steel goes into Goodell-Pratt Hack-Saw Blades. This steel is tempered with the greatest care. For general use they are made with 14 teeth to the inch for sawing iron or steel rods or bars; with 20 or 24 teeth to the inch for sawing brass or heavy tubing; with 32 teeth to the inch for sawing thin steel tubing; and with 8, 10, or 12 teeth to the inch for use in heavy power machines.

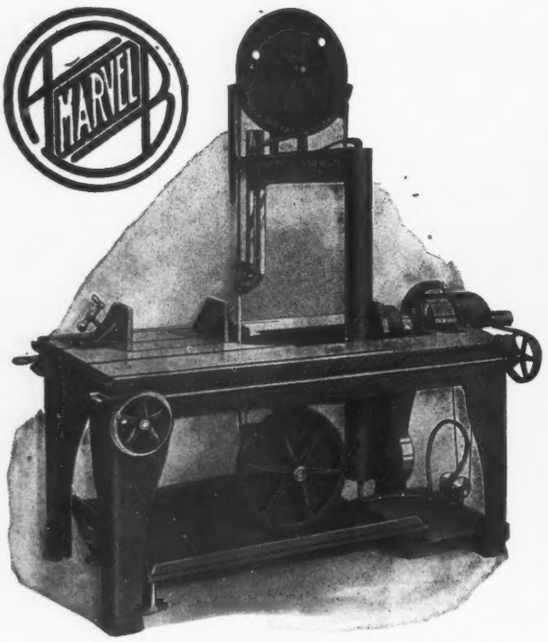
These hack-saw blades live up to the Goodell-Pratt standard of quality. Just as in the manufacture of every other one of the 1500 Goodell-Pratt Tools, nothing is spared which would in any way improve these hack-saw blades.



A complete pocket catalog showing these hack-saw blades and the other 1500 Goodell-Pratt Tools will be sent on request.

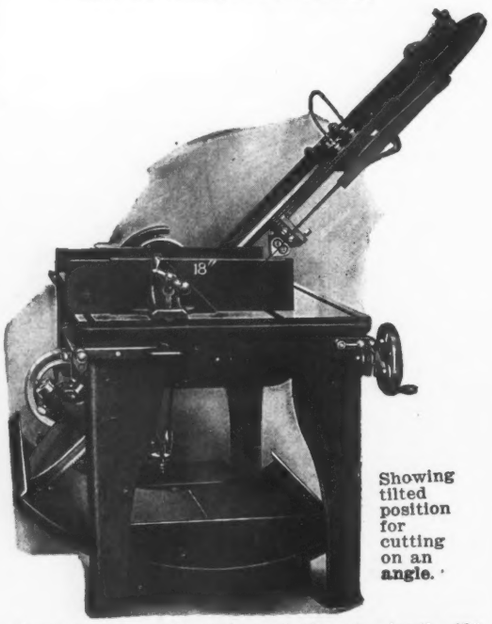
GOODELL-PRATT COMPANY Greenfield, Mass., U.S.A.

The Marvel No. 8 Metal Band Saw



A well-built, serviceable and convenient metal cutting band saw. The saw blade mount is unusually rigid, and may be tilted and locked at any angle up to 45 degrees. The saw blade has double guide rollers in dust-proof cases.

A machine you should know—
may we send you the details?

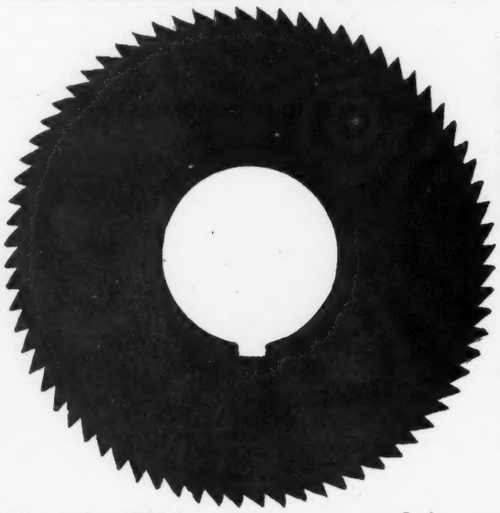


Showing tilted position for cutting on an angle.

Specifications—Capacity of throat—depth 18", height 20". At 45 degrees—depth 18", height 14". Saw blade 14'8". Floor space 36" by 6½'. Catalogue?

ARMSTRONG-BLUM MFG. CO.
343 N. Francisco Avenue Chicago, Illinois, U. S. A.

SIMONDS SLITTERS and SLOTTERS



Used in Machine Shops Everywhere

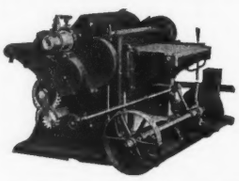
Write for Catalog and Prices

Simonds Slitting Saws are used in many metal working shops as universal saws. They are made of high-grade semi-high-speed steel and stand up to the work. Our screw slotting saws are also in big demand in machine shops and kindred industries.

SIMONDS MANUFACTURING COMPANY
FITCHBURG *"The Saw Makers"* **MASS.**

CHICAGO, ILL. NEW ORLEANS, LA. MONTREAL, QUE.
NEW YORK CITY SAN FRANCISCO, CAL. MEMPHIS, TENN.
PORTLAND, ORE. VANCOUVER, B. C. SEATTLE, WASH.
LOCKPORT, N. Y. LONDON, ENGLAND ST. JOHN, N. B.

Crescent Wood Working Machinery



is popular because the machines are durable and always please our customers. The time will come when you will need additional equipment to help you speed up production so you had better get a little ahead of your requirements and ask for catalog today describing band saws, jointers, saw blades, planers, planers and matchers, disk grinders, swing saws, post borers, shapers, variety wood workers, hollow chisel mortisers, universal wood workers, table cut off saw.

THE CRESCENT MACHINE CO.
56 MAIN STREET LEETONIA, OHIO

Improved Anderson Balancing Ways



They are made in the following sizes

Swing	Greatest Distance Between Standards	Capacity in Lbs.
20 in.	20 in.	1,000
40 "	30 "	2,000
60 "	30 "	2,000
72 "	66 "	5,000
96 "	88 "	10,000

Manufactured by
ANDERSON BROS. MFG. CO., 1910 KISHWAUKEE STREET ROCKFORD, ILL.



Nos. 1, 2 and 5

CUTTING REMARKS

HERCULES SHEARS AND ROD CUTTERS

Are manufactured in six sizes to meet the demand of a quick action tool to speed up production. Cuts rods leaving ends without burrs and minimum distortion—ready to thread.

No. 0 cuts 1/16" flats and under.
No. 1 cuts 3/16" flats and under.
No. 2 and 3 cut ¼" flats and under.
No. 4 and 5 cut 5/16" flats and under.

No. 0 cuts rods ⅛", 3/16", ¼" and under.
No. 1 cuts rods ¼", ⅜", ½" and under.
No. 2 cuts rods ⅜", ½", ⅝" and under.
No. 5 cuts rods ½", ⅝", ¾" and under.



Plain Shears 3 and 4

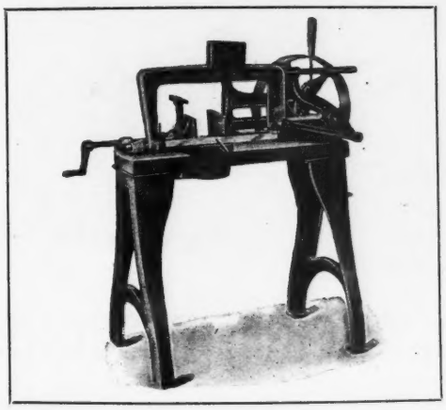
Send for Shear Catalog

Manufactured and For Sale by

W. M. & C. F. TUCKER,

HARTFORD, CONN., U. S. A.

FOREIGN AGENTS: Fenwick Freres & Co., Paris, France; Alfred Herbert, Ltd., Yokohama, Japan; Farmer & Co., London, England.



Q & C Hack Saws

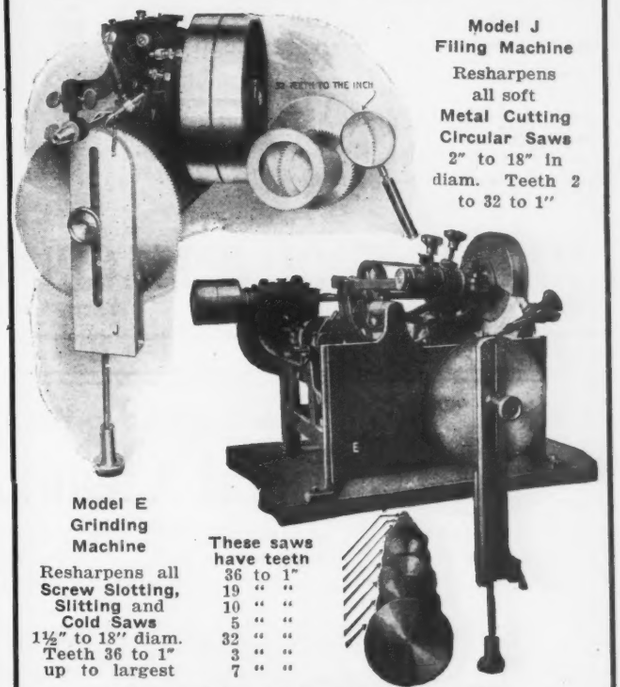
Known the world over

Made in three sizes. For sale by Machinery Dealers, Jobbers and Hardware Stores. Write for descriptive booklet.

HANNA ENGINEERING WORKS

1763 Elston Avenue Chicago, U. S. A.

Automatic Machines for Sharpening Metal Cutting Circular Saws



Model J Filing Machine

Resharpens all soft Metal Cutting Circular Saws 2" to 18" in diam. Teeth 2 to 32 to 1"

Model E Grinding Machine

Resharpens all	These saws have teeth
Screw Slotting,	36 to 1"
Slitting and	19 " "
Cold Saws	10 " "
1½" to 18" diam.	5 " "
Teeth 36 to 1"	32 " "
up to largest	3 " "
	7 " "

The Wardwell Mfg. Co.

Specialty Manufacturers

Combination Band Saw Filing and Setting Machines, Circular Saw Filers, Hack Saw Grinders, Metal Cutting Band Saw Grinders, etc.

108 HAMILTON AVE. CLEVELAND, OHIO

EXPANDED METAL SAFETY GUARD CO.

14th St. and Vernon Ave. Long Island City, N. Y.

The highest type of engineering and construction service in the design, manufacture and intallation of

MACHINE GUARDS

SCREENS OF ALL KINDS

Chicago Perforating Co.

2445 West 24th Place

Tel. Canal 1459 CHICAGO, ILL.

Perforated Metal Machinery Guards

WILL CUT ANY STANDARD KEYWAY



Model "A"

The important feature of this machine is its portability; instead of taking the work to the machine, the Bucher-Smith Portable Keyseater

Is Taken to the Work

This machine is furnished with five milling cutters which can be ganged up to cut from ¼" to 1¼" wide and up to 12" long in shafts 1¼" to 5" diameter without resetting.

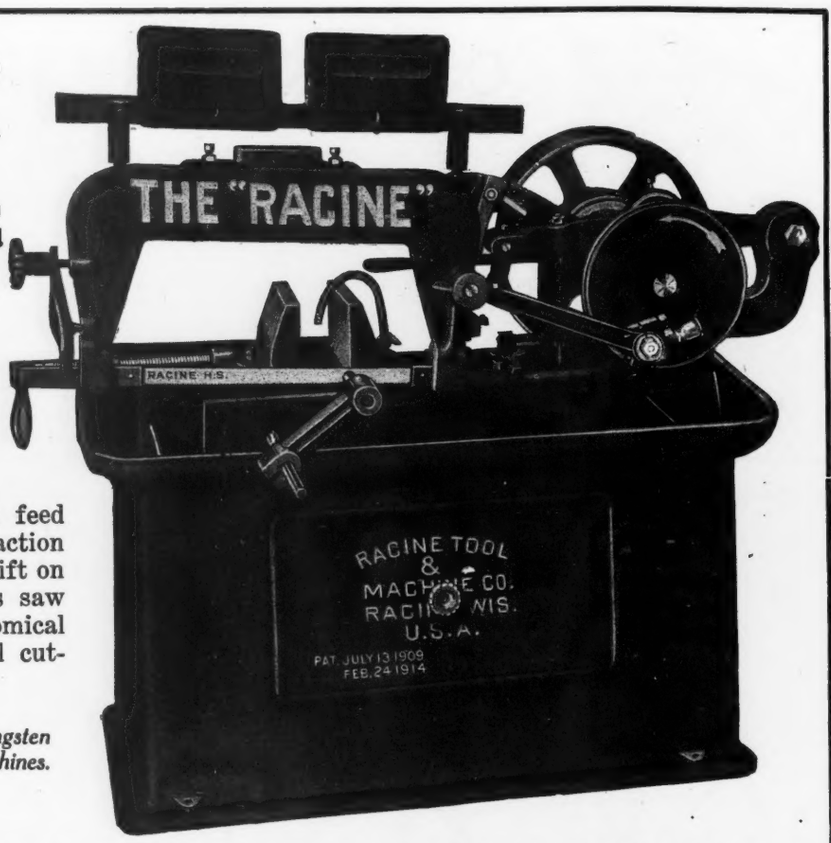
Write for Catalog and price list

THE BUCHER-SMITH COMPANY

Engineers and Machinists

EAST LIVERPOOL, O.

THE "RACINE" HIGH SPEED METAL CUTTING MACHINES



The combination quick change vise grips the work close to the saw blade and enables the operator to cut short pieces accurately *at any angle;* automatic stock feed saves labor. The draw cut action of the saw with the positive lift on the non-cutting stroke saves saw blades. Convenient, economical machines for accurate metal cutting.

Use The "RACINE" H. S. Tungsten Power Blades with these machines. "Standard the World Over."

RACINE TOOL & MACHINE CO., RACINE, WISCONSIN

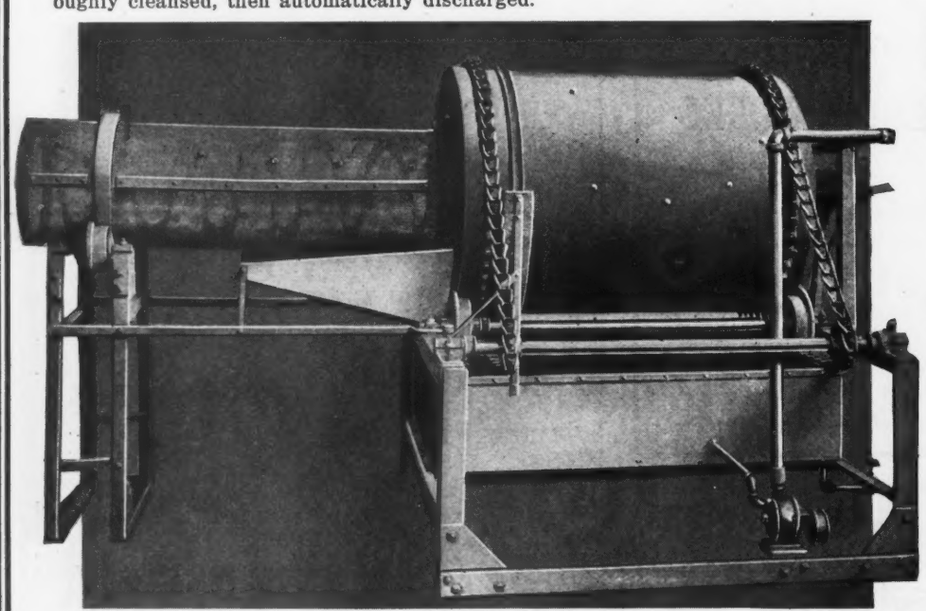
250 Fifteenth Street

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Ideal Metal Cleaning Machinery Proves a Faithful Servant

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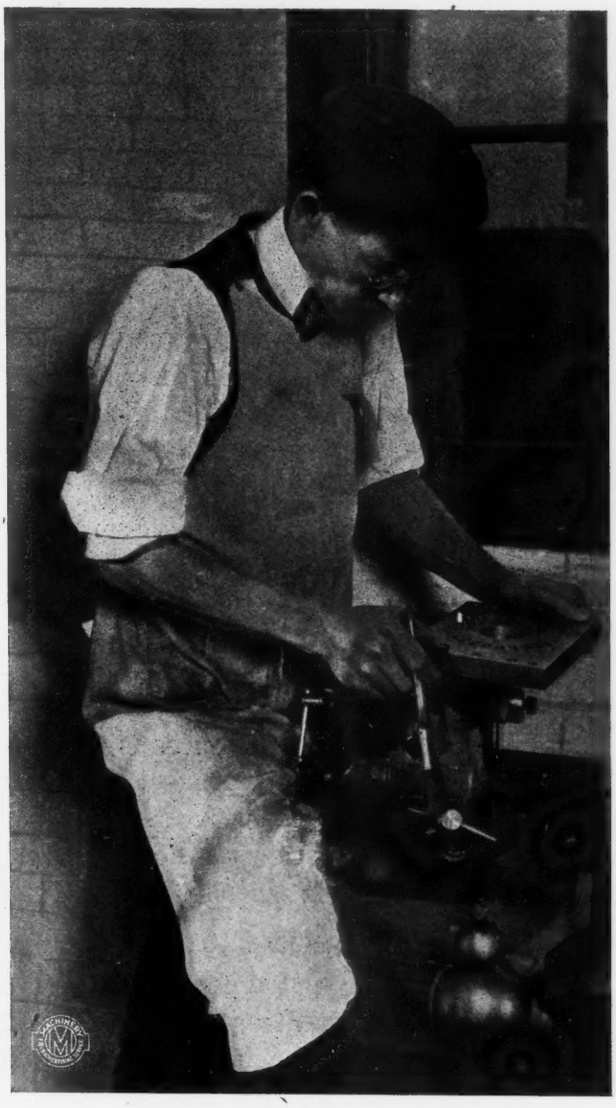
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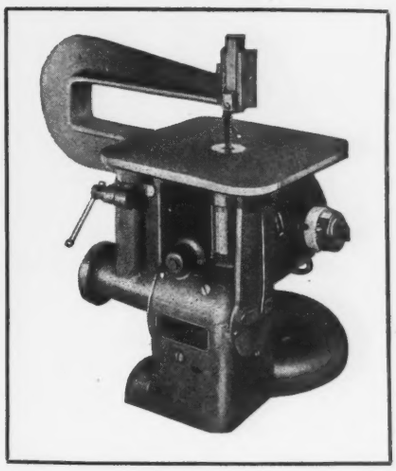
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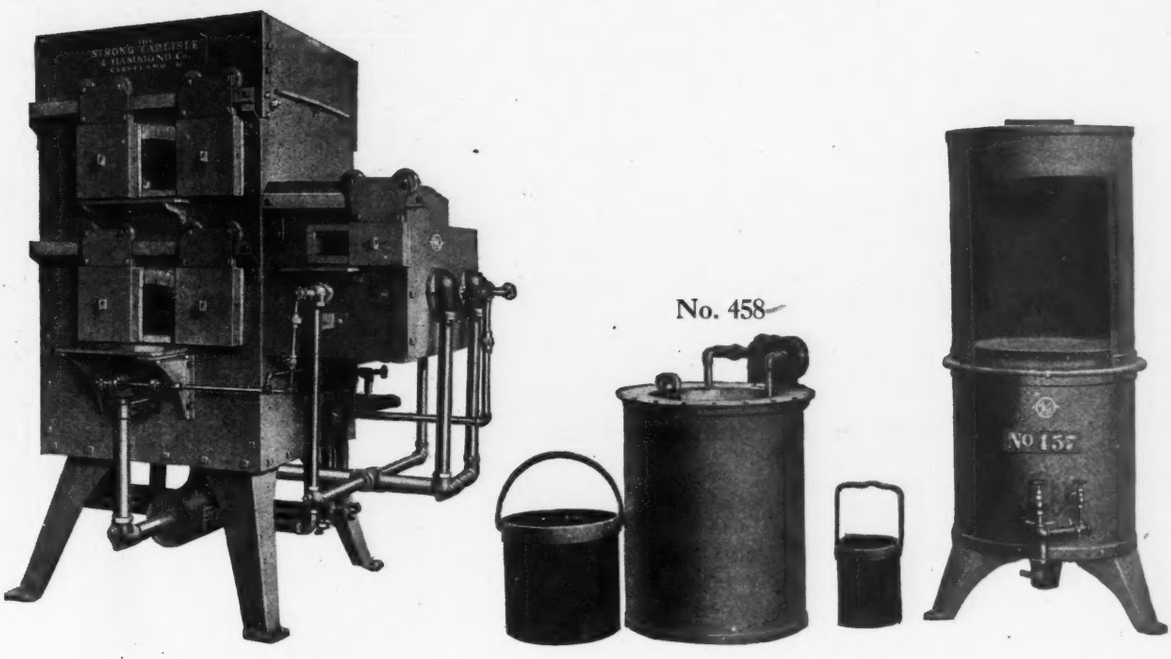
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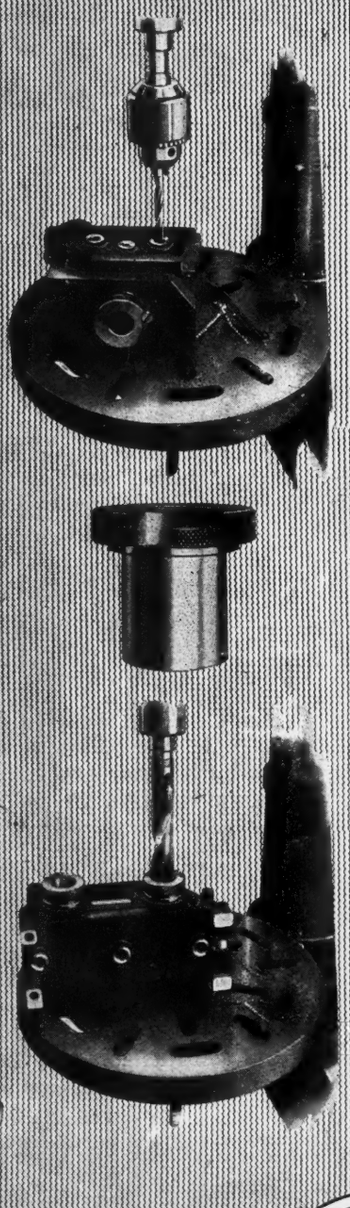
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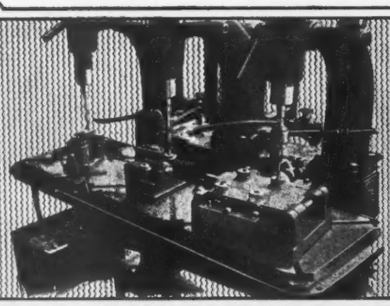
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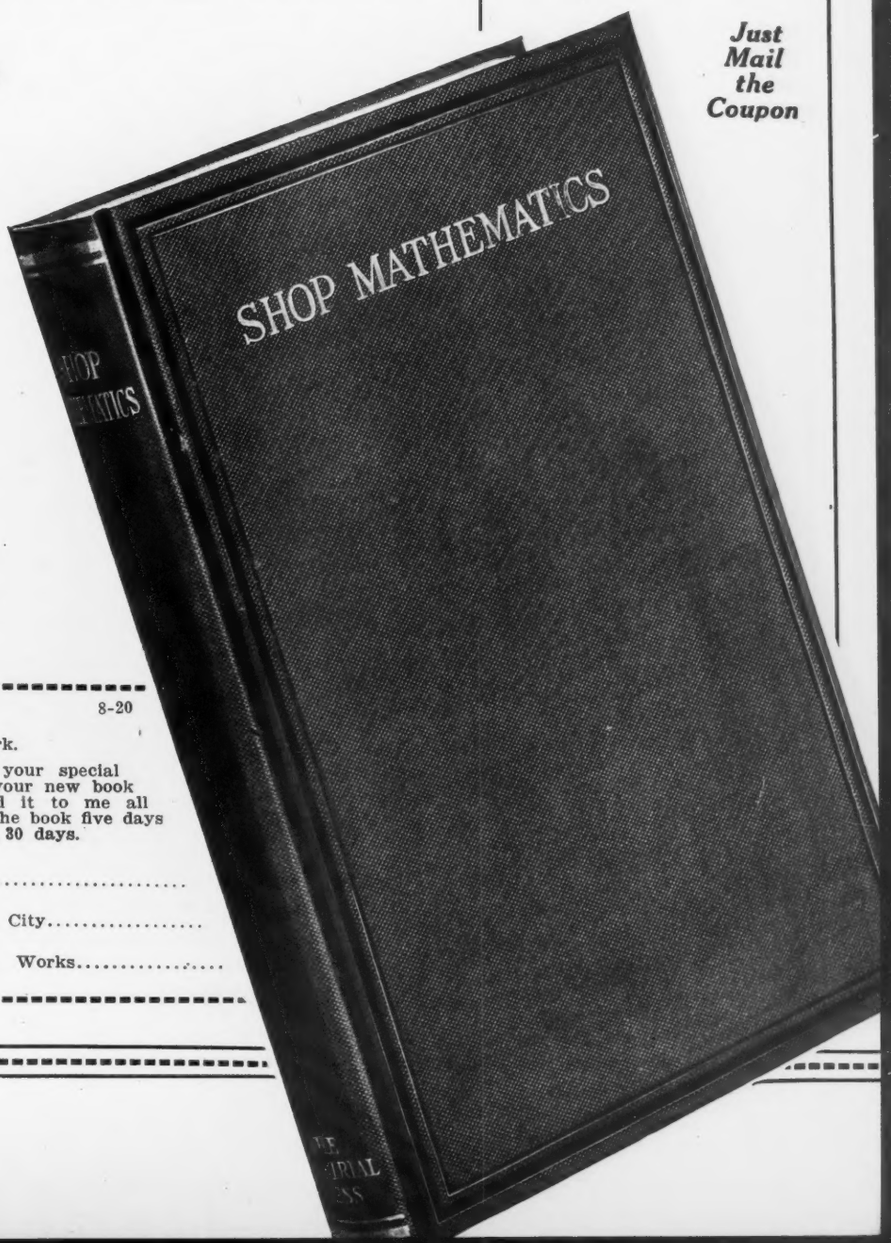
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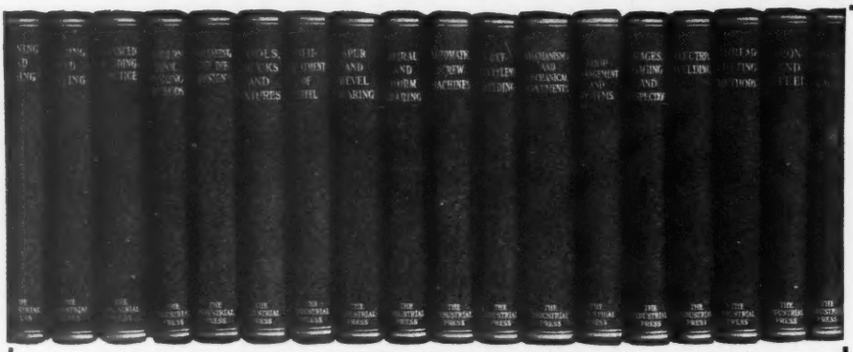
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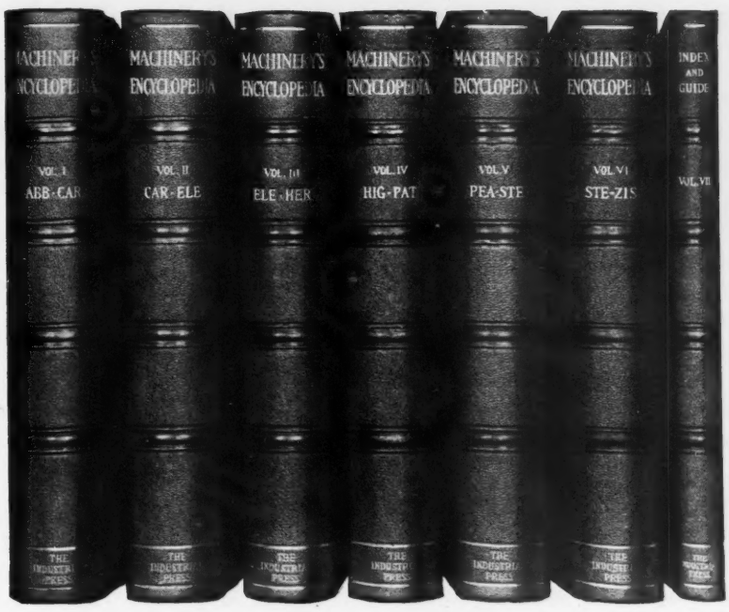
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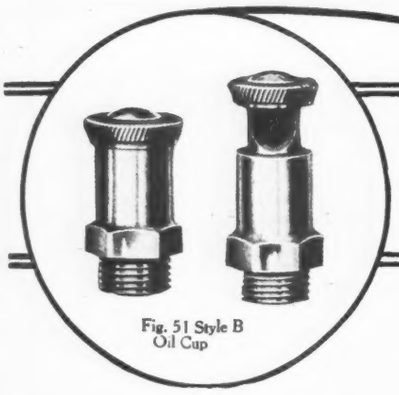


Fig. 51 Style B Oil Cup

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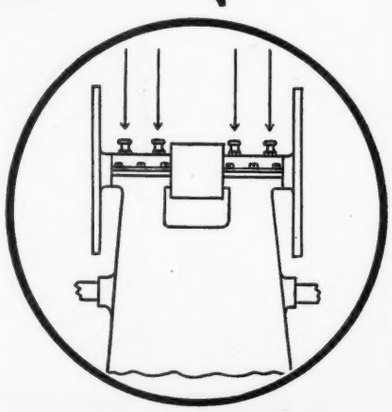
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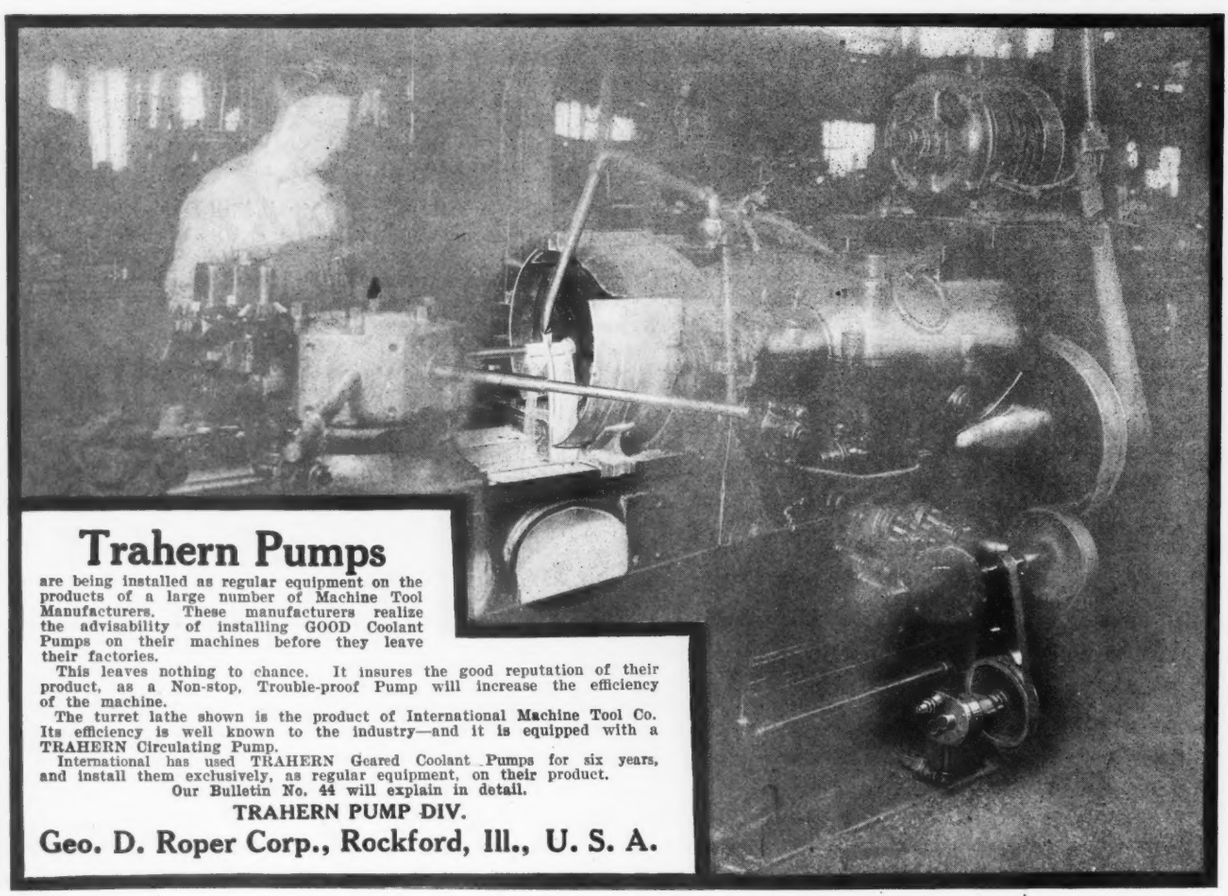


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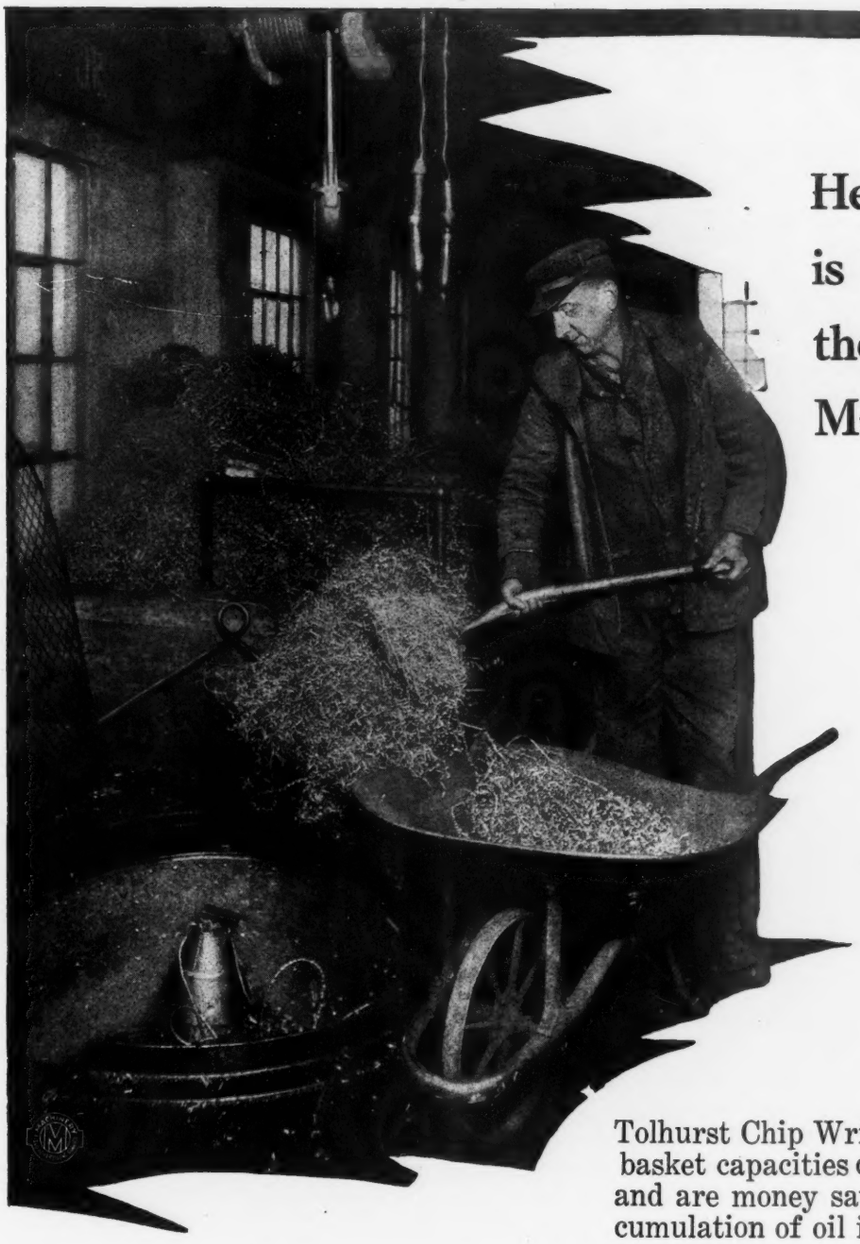
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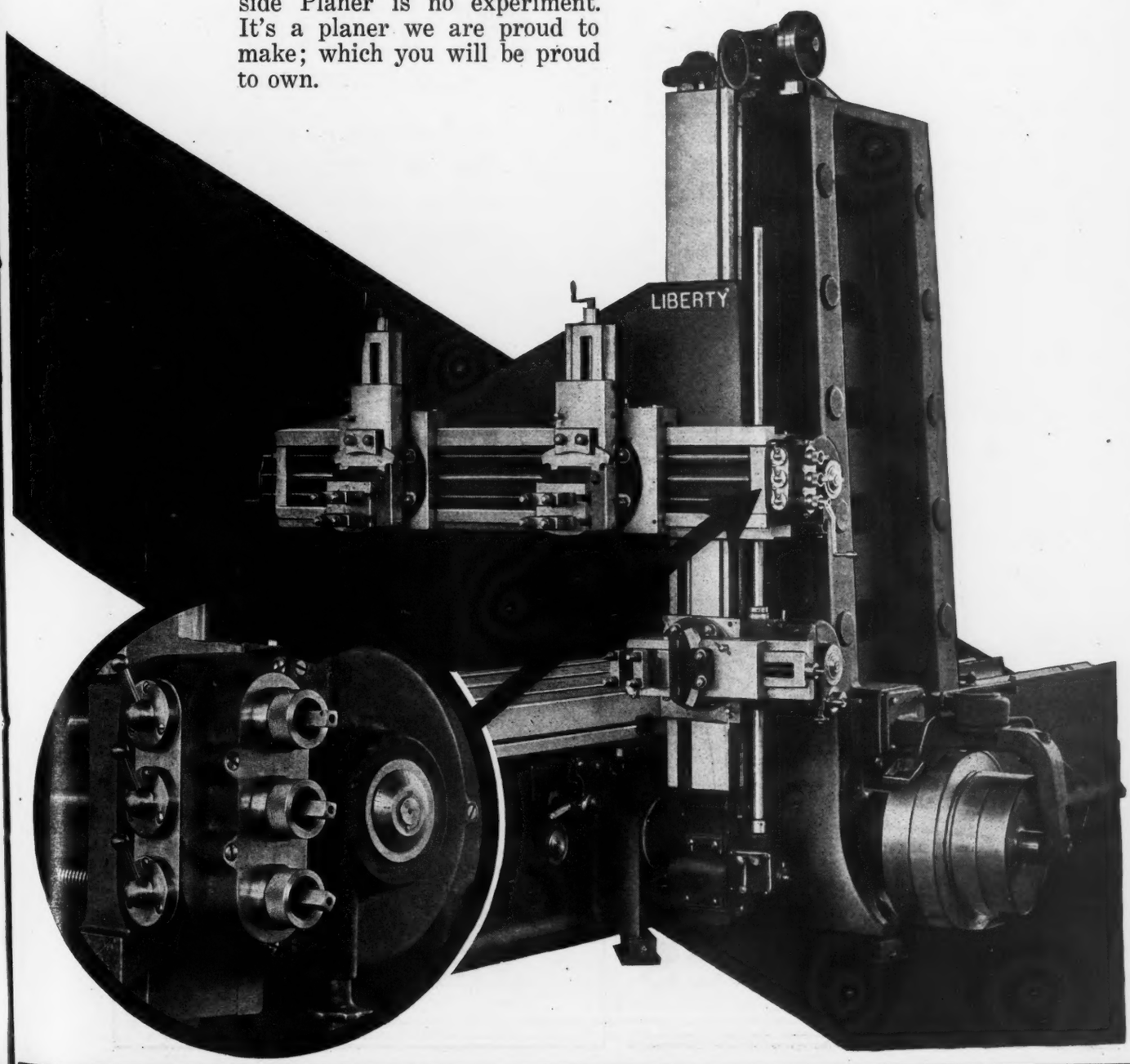
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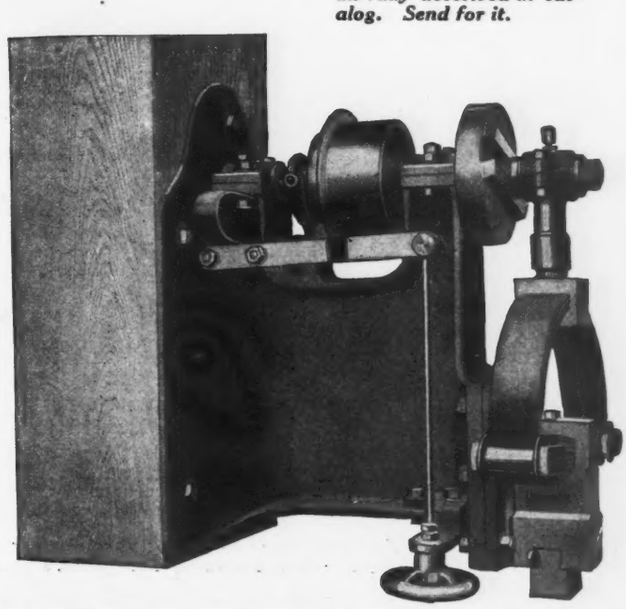
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This hammer is used also for hammering out automobile pans and straightening out doors, bodies and other parts of sheet steel up to No. 16 Birmingham Gage.



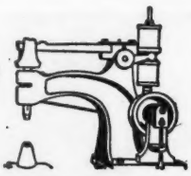
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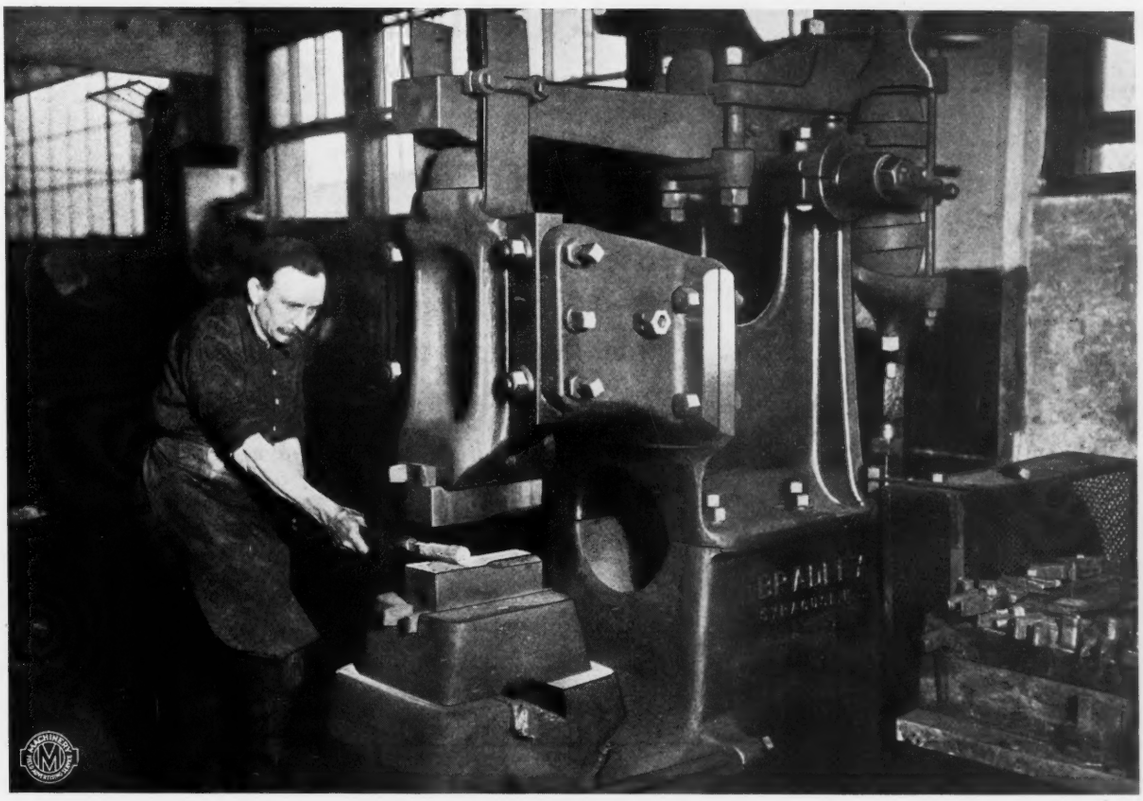
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Ten Years With the Brown-Lipe-Chapin Co.

Nearly 3,000 men are employed in manufacturing gears, automobile transmissions, etc., in this big factory. The blacksmith shop is a busy place—and here a veteran 300-pound Bradley Hammer is used continuously, drawing down and reworking old high speed steel drills, reamers, etc., and making them over into cutting tools for use on the big automatics—salvaging hundreds of pounds of high speed steel every year.

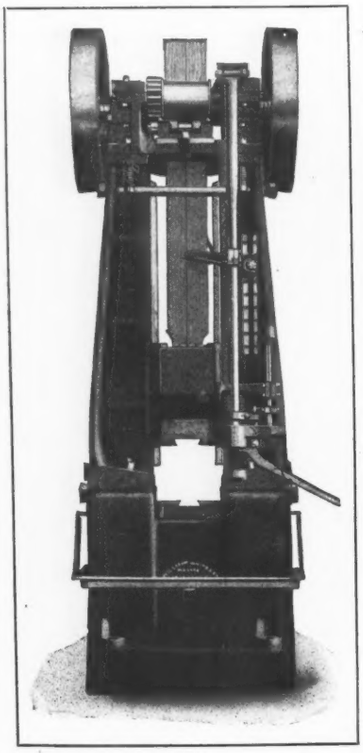
Bradley Hammers are one-man tools of unusual range and versatility—big producers, but easy to operate, and always under instant control.

Let us tell you more about them and explain their application to your work

C. C. BRADLEY & SON, Inc., Syracuse, N. Y.

(ESTABLISHED 1832)

FOREIGN AGENTS: England—Buck & Hickman, Ltd., London. **France**—Fenwick Freres & Co., Paris, Lyon, Rhone, **Italy**—Fenwick Freres & Co., Turin. **Belgium**—Fenwick Freres & Co., Liege. **Brazil**—Fenwick Freres & Co., Rio de Janiero. **Switzerland**—Fenwick Freres & Co., Zurich. **Spain**—Fenwick Freres & Co., Barcelona. **Portugal**—Fenwick Freres & Co., Lisbon. **Alsace-Lorraine**—Fenwick Freres & Co., Luxemburg.



IN STOCK

Two 2,500-Pound Board Drop Hammers—Subject to Prior Sale

The two machines are new and of the very latest construction, similar to the cut shown. They are of the geared type with alloy steel cut gears, pivoted latch, floating clamp, and steel ram and sow block.

Details will be furnished upon request

Williams, White & Co.
Moline, Ill.
U.S.A.

PITTSBURGH OFFICE 808 House Building | NEW YORK OFFICE 30 Church Street | CHICAGO OFFICE 1624 Monadnock Block | DETROIT OFFICE 65 Shelby Street

A NAZEL HAMMER

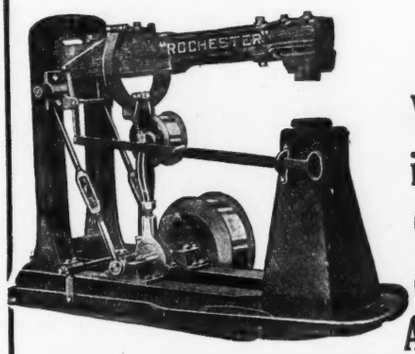


Makes Every Minute Count

Forging at the Pennsylvania Forge Company's shops (Philadelphia) is job work entirely—every minute counts—and a motor driven Nazel Hammer was the natural selection because of its ready control and speed. The Nazel Air Hammer is a self-contained unit, ready for use instantly—the hammer for economy in forging.

Ask for the catalog

NAZEL ENGINEERING WORKS
4043 No. 5th Street
PHILADELPHIA PA.



What is the Object of an Advertisement?

To gain your attention long enough to arouse interest. The only way the Advertiser can know if he is successful in this, is by hearing from you. Our assumption is that if you are interested in Helve Hammers at all, you cannot help but be interested in the

Rochester Helve Hammer

It is unique; substantial; reliable; economical and worth-while in the fullest mechanical sense. It is made in six sizes, a choice of two styles of frames, moderate in cost, exceptional in results.

Our illustrated Rochester Helve Hammer Book is yours for the asking. May we send it to you?

THE WEST TIRE SETTER CO.
ROCHESTER, N. Y.



Fairbanks-Dupont Power Hammers

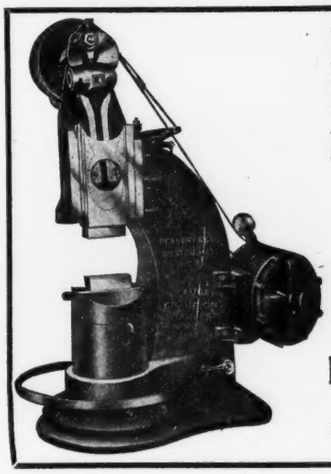
25 to 300 lbs.

BELT OR MOTOR DRIVE

These Hammers Embody a Design and Workmanship that are unsurpassed.

Send for Catalog

UNITED HAMMER CO.
45 Bromfield St., Boston, Mass.



BEAUDRY HAMMERS

For General Forging

Save Fuel, Time and Labor. Cut Forging Costs in Two

Belt or Motor Driven

BEAUDRY & CO., Inc.
45 Bromfield Street
BOSTON :: MASS.

Little Giant Power Hammers Put the Serve in Service



Little Giant Hammers began work over 26 years ago and so far as we've been able to learn none has ever been retired from active service. There are over 10,000 in daily operation; annual repair sales for all Little Giants sold, first to last averaged 48 cents each, or less than two-fifths of one per cent. of original cost. Little Giants are guaranteed forever against defective material and workmanship. 25, 50, 100, 250 and 500 lb. models—prompt shipment.

Belt Driven



Special Dies for any forging purpose. For prices send drawings or samples.

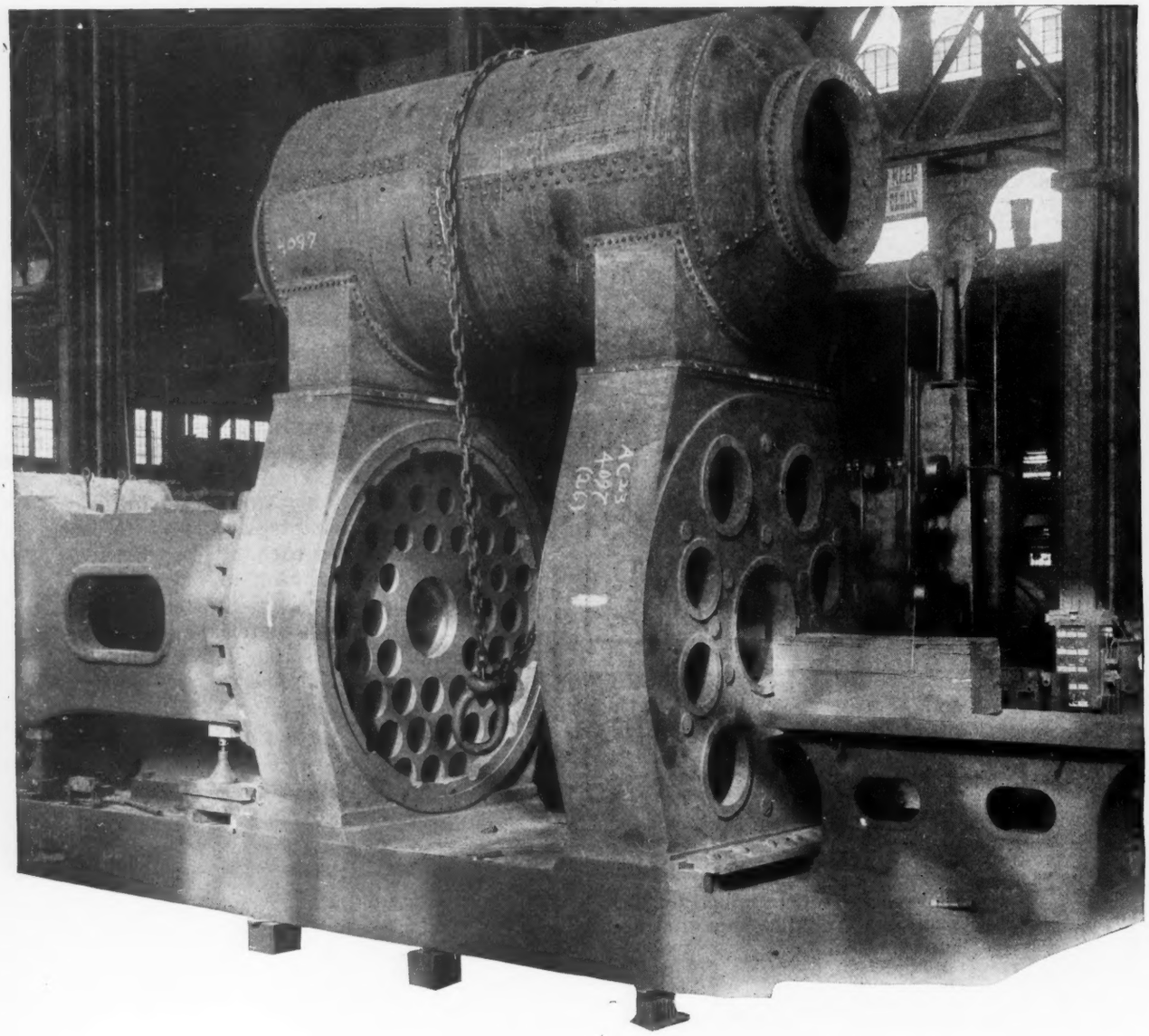


LITTLE GIANT COMPANY

Established A. D. 1876

131 Rock St. Mankato, Minn., U. S. A.

HAMILTON



The Exception That Proved the Rule

Corliss Engines
Poppet Valve Engines
Uniflow Engines
Gas Engines
Gas Steam Engines
Marine Engines

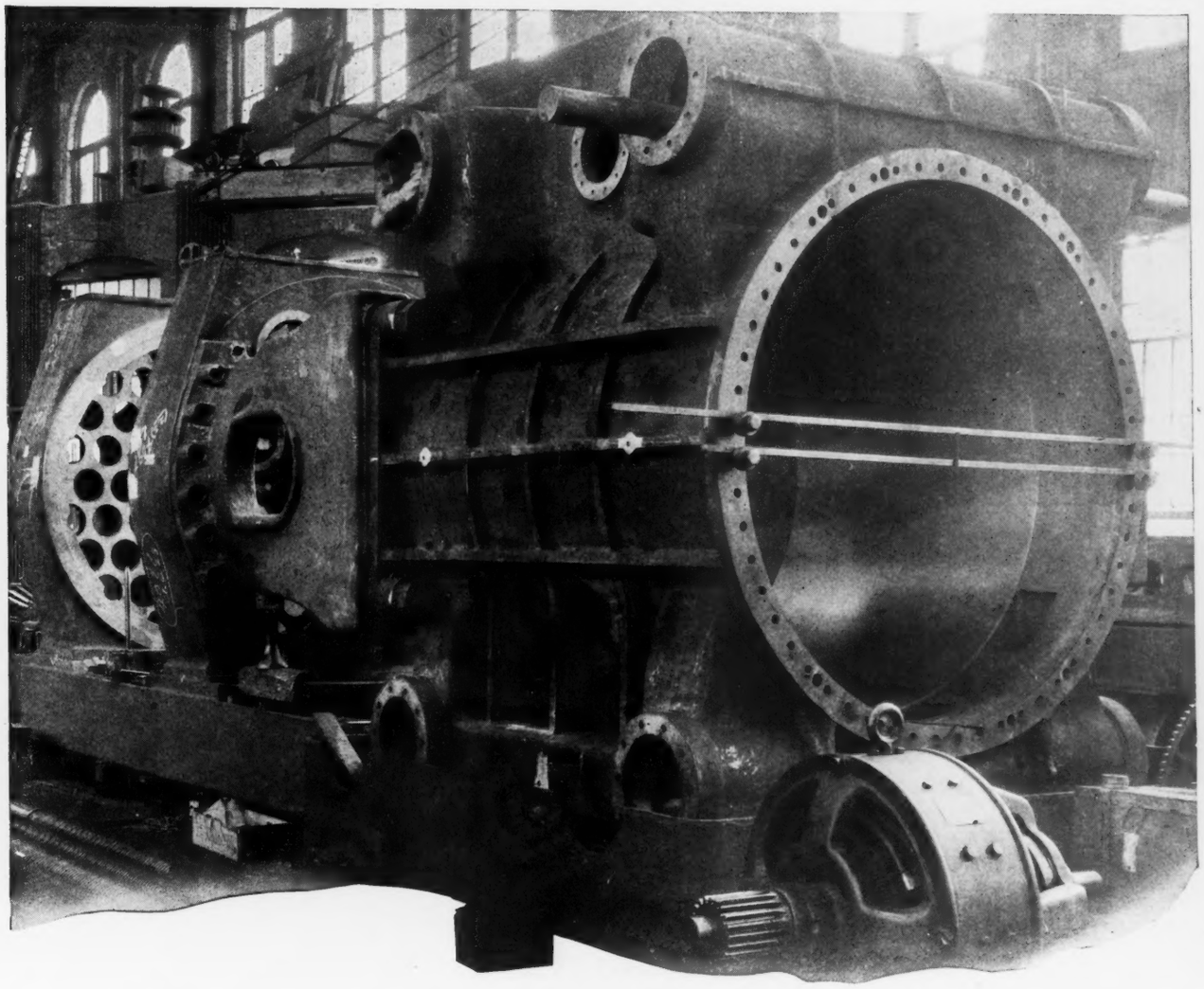
Every Hamilton engine is fully assembled and tested before shipment. That's the rule.

In one case the urgent need of war materials compelled us to break the rule.

The big cylinders shown in these illustrations are parts of a blowing engine for a steel mill blast furnace. The size of the complete installation can be gauged by the weight—925,000 lbs.



ENGINES



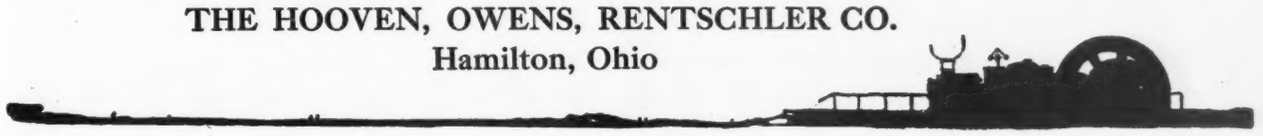
Blowing engine air cylinders for Cambria Steel Co.

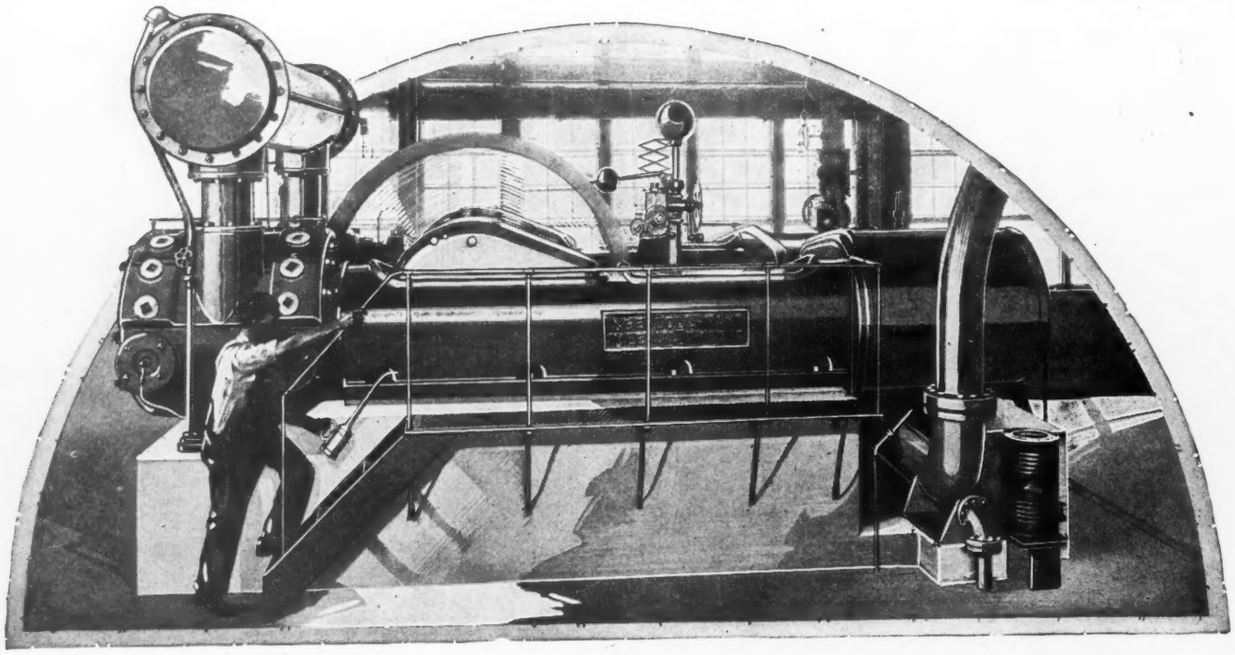
This was not assembled at the shop but delivered in parts to the customer—and when the engineers on the job assembled them, every part fitted perfectly. There was nothing to grind, file, or machine. It demonstrated the truth that all Hamilton workmen are thoroughly grounded in: The perfection of the whole is the sum of perfection in the parts.

We sincerely hope that conditions will never compel us to ship another unassembled engine—yet we are glad that this exception proved the quality of *all* Hamilton engines.

If you want any information regarding steam engine power, write to our engineering department. Consider them your consultants—without fee.

THE HOOVEN, OWENS, RENTSCHLER CO.
Hamilton, Ohio





INGERSOLL-RAND Imperial Type XPV COMPRESSORS

SAVE FUEL

FUEL is now expensive and difficult to obtain—therefore save fuel.

"Imperial" XPV steam driven compressors with balanced piston steam valves and automatic cut-off governor have a steam economy equal to that of full Corliss machines of the same capacity.

"Imperial" XPV compressors are built for use with any commercial steam pressure or superheat.

These and many other features account for the high overall efficiency of XPV compressors.

Bulletin 3033 will tell you all about these.
Send for your copy.

INGERSOLL-RAND COMPANY
11 Broadway, New York
Offices Everywhere

438-C

Ingersoll-Rand

Well sir, there's nothing wrong with that thread!



Not a thing wrong with it. This Forbes' has cut each V sharp at the bottom and just a little flat on top, which is right. Not only that, but each side of the V's are cut true.

That's something I never found in using other power machines. You see, boys, in most machines they make the dies drag the heavy pipe, while threading it. So of course a deeper slant is cut on one side of each thread. This isn't a very large piece of pipe, but you take 10 feet of this, or a larger size and you've got considerable weight. After all, it's the dies that do the work, and if they are allowed to cut thread only, and don't have a lot of heavy dragging to do besides, the thread is bound to be perfect.

That's what the Chief told me about this Forbes' Pipe Threading and Cutting Machine: "The die head revolves, and the pipe remains stationary."

Yes, sir, I sure am going to like this Forbes'!

We can send you a Forbes' Pipe Threading and Cutting Machine which will probably handle all the pipe sizes you use. And you, too, will like it, because it is the all-round practical machine for plant or plumbing establishment. Write us for further details.

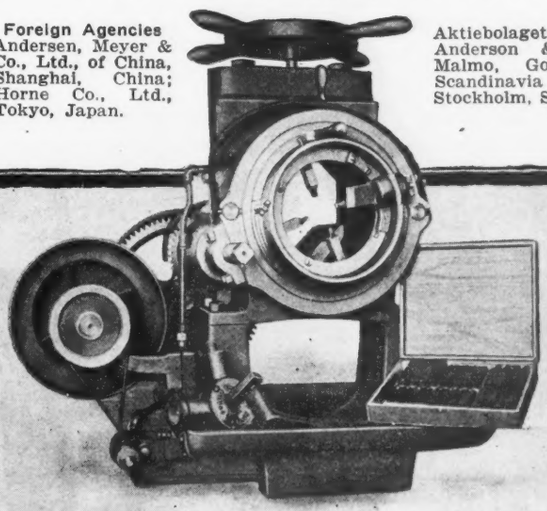
CURTIS & CURTIS CO.

324 Garden Street, Bridgeport, Conn., U. S. A.

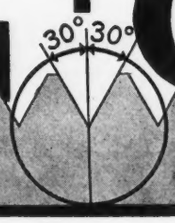
Foreign Agencies
Andersen, Meyer & Co., Ltd., of China, Shanghai, China; Horne Co., Ltd., Tokyo, Japan.

Aktiebolaget Sigfr. Anderson & Co., Malmo, Goteborg, Scandinavia and Stockholm, Sweden.

2031-K

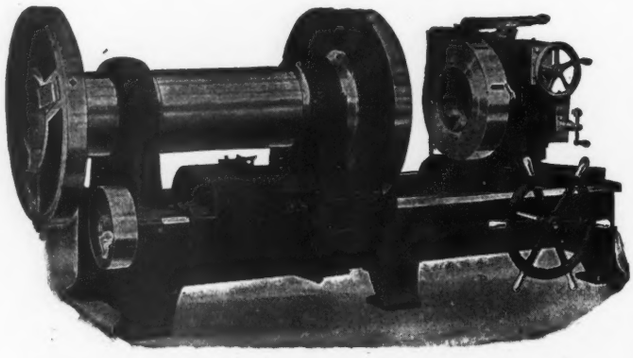


FORBES'



IT THREADS PIPE ACCURATELY

PEERLESS B&K DUPLEX P·D·Q·C



ALWAYS ON THE JOB

READY for threading pipe any moment from Monday morning to Saturday night—overtime too, if needed. Continuous satisfactory service in a machine starts in the designing. There is where every little detail is studied with a view of producing a finished machine that will stand the hard knocks. Every part will sooner or later be called upon to stand right up to hard work. The dies, the die adjusting device, the cut-off, the chucks, the oiling system, should all be dependable. B & K machines have that look of strength and bigness that you like to see in a pipe machine. *Send for a catalog.*

FORGE AHEAD WITH A BETTER THREAD

BIGNALL & KEELER MACHINE WORKS

EDWARDSVILLE, ILL.

PEERLESS B&K DUPLEX P·D·Q·C

PEERLESS B&K DUPLEX P·D·Q·C

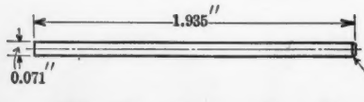


This DAYTON SWAGING MACHINE

Helps in the Economical Production of Modern Office Equipment

Efficiency, the watchword of the Elliott-Fisher Co. office devices is also their manufacturing standard. This photograph shows the Dayton Swaging Machine chamfering a wire end for entrance into the reducing die at 1000 pieces per hour. An operation that seems to indicate that the equipment of this Harrisburg Plant is as efficient as the machines they make.

May we tell you more of the varied uses for Dayton Swaging Machines?



The Torrington Co., Excelsior Plant

Successors to Excelsior Needle Co.

57 Field Street **Torrington, Conn.**

Coventry Swaging Co., Ltd., White Friars Lane, Coventry, England, Agents for Great Britain. Fenwick Freres & Co., 8 Rue de Rocroy, Paris, France, Agents for France, Italy, Belgium, Spain, Portugal and Switzerland.

You'll Find Etna Swaging Worth While



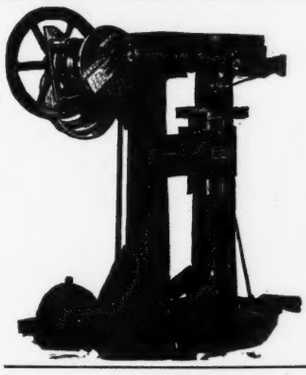
No. 5

For pointing, tapering, or otherwise reducing metal rods and tubes, for forming a wide variety of metal parts, from button-hooks to automobile steering rods, you'll find Etna Swaging far superior to turning or grinding.

Thousands of hammerlike blows from rapidly-revolving dies impart to the metal the quality of a forging, and simplicity in operating assures rapid, economical output.

The capacity of Etna Machines varies, this No. 5 Machine being adapted to handle work up to 4″ diameter and tapers to 18″ long. All, however, have the extra outer bearing and other distinctive features that insure a long term of profitable service. Details on request.

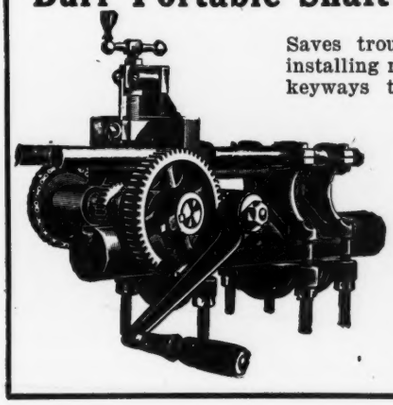
THE ETNA MACHINE CO.
Maplewood Avenue and Castle Blvd.
TOLEDO OHIO, U. S. A.



Brand your trade-mark into your product—and your advertising will go 'round the world. **Dwight-Slate Marking Machines** cut permanent trade-marks. Our up-to-the-minute steel engraving department will supply the dies for the work. Write for booklet of samples and list of users.

NOBLE & WESTBROOK MFG. COMPANY
19 ASYLUM STREET HARTFORD, CONN.

Burr Portable Shaft Keyseater



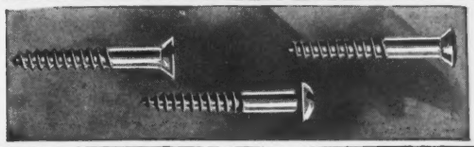
Saves trouble—cuts costs of installing new machines. Cuts keyways to 5″ in diameter and 12″ long without resetting and without dismantling the shafting.

Circular?

JOHN T. BURR & SON
429 KENT AVE.
BROOKLYN, N.Y.

Wood Screw Making Machinery

Send for Catalogue Series B-3



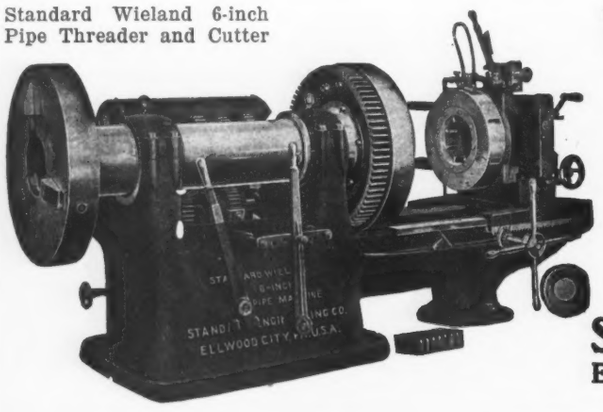
For sixty years we have constantly manufactured machinery for making screws, always studying to improve and refine our product.

Write or Wire us

Cable Address: "Cook," Hartford, U.S.A.
Codes: Liebers, Western Union

Asa S. Cook Co.
Hartford, Conn.

Standard Wieland 6-inch Pipe Threader and Cutter



Thread Pipe Do You? How?

The modern, efficient way is the Standard Wieland way, with a heavy, sturdy, durable machine, simple and positive in operation, fast and accurate in production.

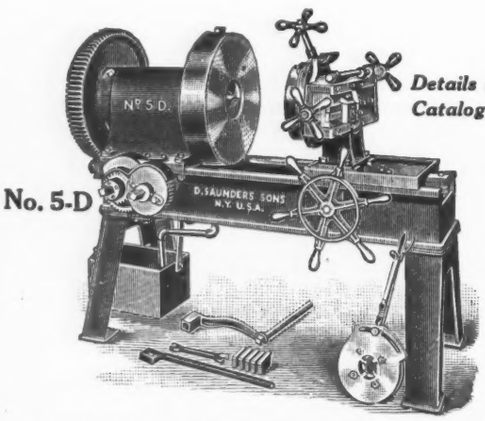
A few features: One-piece bed; single-speed pulleys; gear speed changes through semi-steel cut gears; deep chasers, cutting long taper threads in one cut perfectly, steel as well as iron pipe.

Send for the Circular.

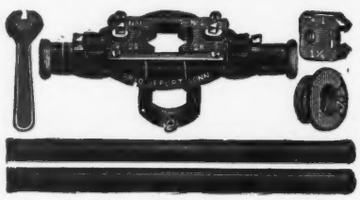
Standard Engineering Company
ELLWOOD CITY PENNSYLVANIA
San Francisco Office: 1801 Claus Spreckles Bldg.

Saunders Machines Thread and Cut Pipe up to 18" Diameter

Powerful, well-built machines with speed, accuracy and operating convenience developed to the maximum. This No. 5-D Model, for example, threads pipe up to six inches in diameter, and is arranged for operation by both belt and hand power, equipped with Adjustable Expanding Die Heads with Interchangeable Chasers, and is arranged with eight speeds, giving uniform speed for each size of pipe threaded by machine.



D. SAUNDERS' SONS
Yonkers New York



Genuine Armstrong Stocks and Dies

Some of the advantages of the ARMSTRONG Stocks and Dies:
Can be adjusted to the variations in the size of fittings.
Results are accomplished with less work and time.
Can be sharpened without drawing the temper.
The dies are interchangeable in the stocks.

Have you a Set in Your Kit ?

Our catalog tells the rest of this interesting story, send for it today.

THE ARMSTRONG MFG. CO.
297 Knowlton Street Bridgeport, Conn.

MERRELL Pipe Threading and Cutting Machinery

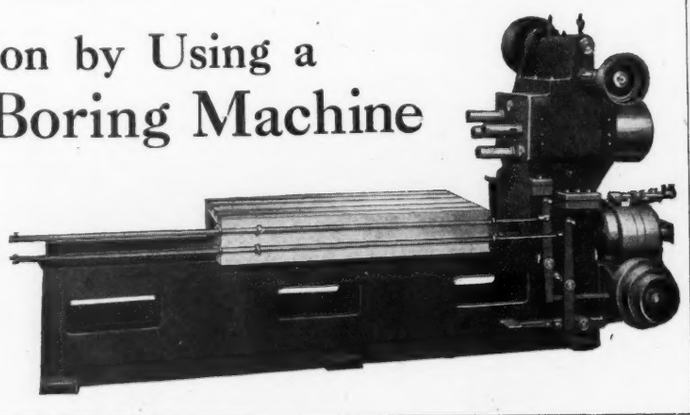
Hand or Power Operated

THE MERRELL MFG. COMPANY
15 Curtis Street TOLEDO, OHIO

CHAMBERSBURG HAMMERS

STEAM DROP—BOARD DROP—SINGLE AND DOUBLE FRAME TYPES
All Sizes for Every Class of Forging Work
HYDRAULIC MACHINERY
CHAMBERSBURG ENGINEERING CO., Chambersburg, Pa.
Send for Catalog

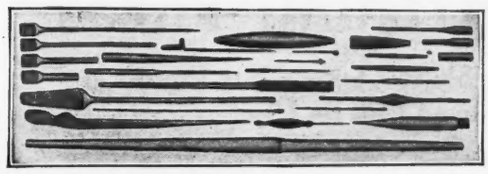
Increase Production by Using a Multiple Spindle Boring Machine

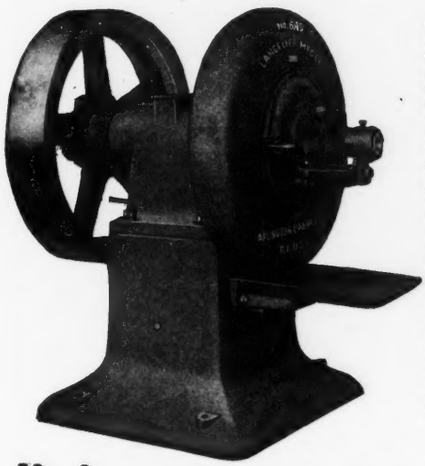


Built by
MOLINE MACHINERY COMPANY
MOLINE ILLINOIS

ROTARY SWAGING

The MODERN METHOD of Accurately Forming Metal with ECONOMY





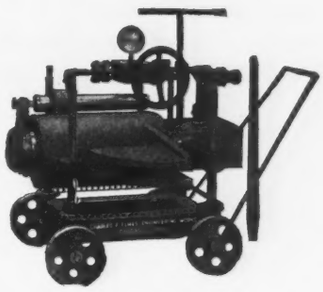
The function of these machines is the reduction sizing or tapering of metals of round, square, hexagonal or other section to a circular section either solid or tubular and hot or cold by power actuated dies striking up to as many as 3000 blows per minute.

Our policy is to equip the machines in every detail with work holders and feeding devices as will enable them to give the most efficient service at low upkeep expense when operated by unskilled labor.

Machines built up to date, have capacities ranging from a pin point up to 2½" diameter on solid stock and up to 5½" on tubing.

LANGELIER MFG. COMPANY
Arlington, Cranston, R. I., U. S. A.

ELMES
Chicago—Hydraulics



We wish to thank the machinery users of America and foreign countries for assisting us in making this press the greatest seller in the world.

Charles F. Elmes Engineering Works
Established 1861 Incorporated 1895
222 N. MORGAN STREET CHICAGO, U. S. A.

Drop Presses

for all purposes our specialty

The
Peck Drop Lifter
can be readily applied to foot or hand drops, making them automatic

MINER & PECK MFG. CO.
Proprietors of the PECK DROP PRESS WORKS
NEW HAVEN CONN., U. S. A.

PRESSES—Foot and Power.
WIRE FORMING MACHINES—Standard or special.
TUMBLERS—All kinds.
BALL BURNISHING EQUIPMENT.

BAIRD MACHINE CO.
BRIDGEPORT, CONN.

PRESSES AND SHEARS

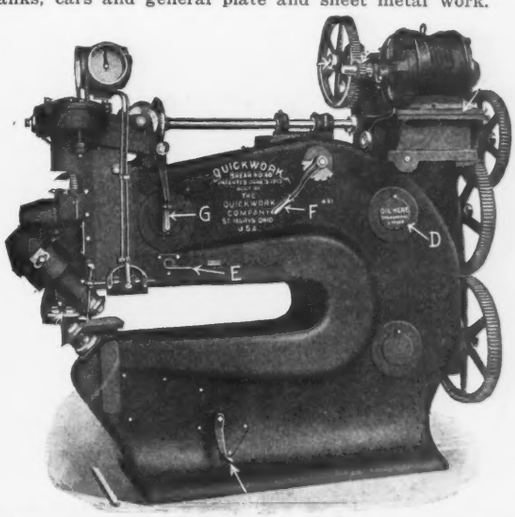
SHEET METAL WORKING MACHINERY

THE D. H. STOLL COMPANY, Inc.
Military Road and Grote Street, BUFFALO, NEW YORK

QUICKWORK
Registered in U.S.A. and Foreign Countries
ROTARY SHEARS

MADE IN SEVEN SIZES

Cut all gauges of sheet and plate metal up to 1 inch thick in straight or irregular shapes and openings without cutting in from side of sheet. Leaves square true edge that requires no finishing. Used in building ships, boilers, tanks, cars and general plate and sheet metal work.



Patented June 3rd, 1913. Write for Catalogue No. 60

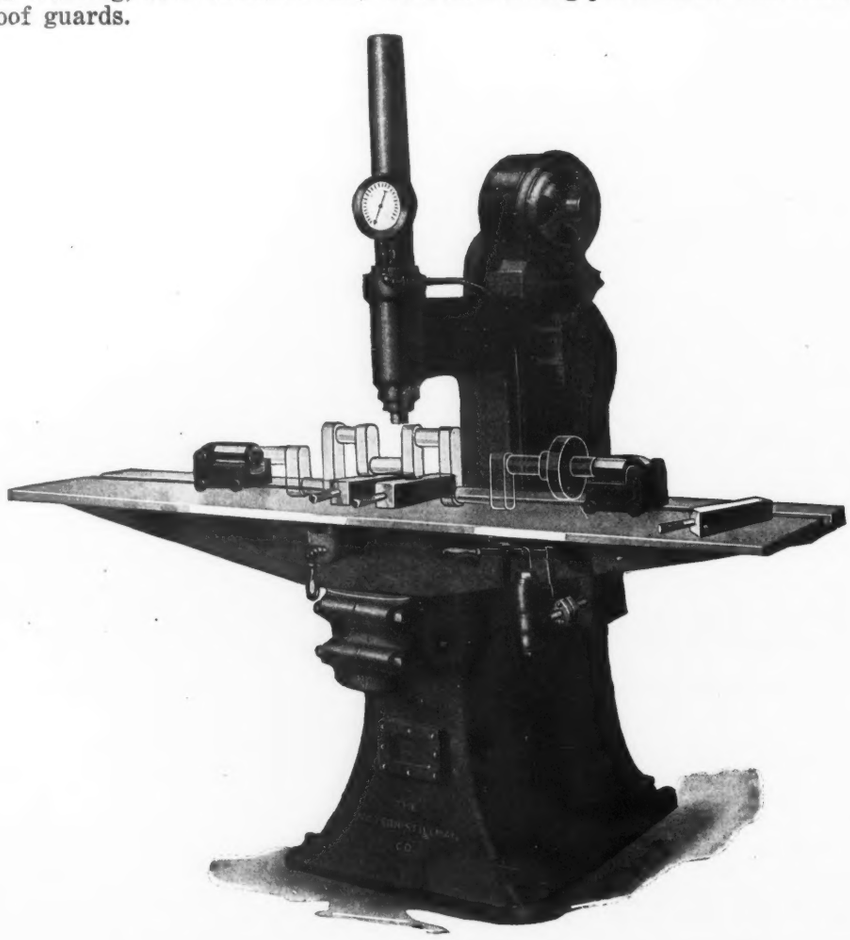
SAVES 50% to 90%
Eliminates Oxyacetylene Cutting and Plate Planing

THE QUICKWORK CO., St. Marys, Ohio, U. S. A.
New York Exhibit: Grand Central Palace
Foreign Agents: British Isles, Oliver Machinery Co., Manchester, England
Japan, T. H. Ohyama, Tokio
Cable Address, "QUICKWORK" Codes: W. U. and General

WATSON-STILLMAN
HYDRAULIC STRAIGHTENING PRESS

For Straightening Crank Shafts, Cam Shafts, Automobile Front Axles, Etc., or with Table Removed Can Be Used as a Mandrel Press, Broaching Press or Assembling Press

A rapid working, self-contained unit with all working parts under removable dust-proof guards.



This is a quick acting press that is under absolute control of the operator, both as to speed and pressure, by means of a hand or foot operated valve, which is so arranged that the movement of the ram through the low pressure portion of its stroke is very rapid, and the change to high pressure is effected automatically for the actual bending operation.

The table can be easily removed, and in this shape the press becomes a universal purpose forcing press capable of a wide range of shop operations.

Detailed information will be furnished upon request.

WRITE FOR BULLETIN B-19.

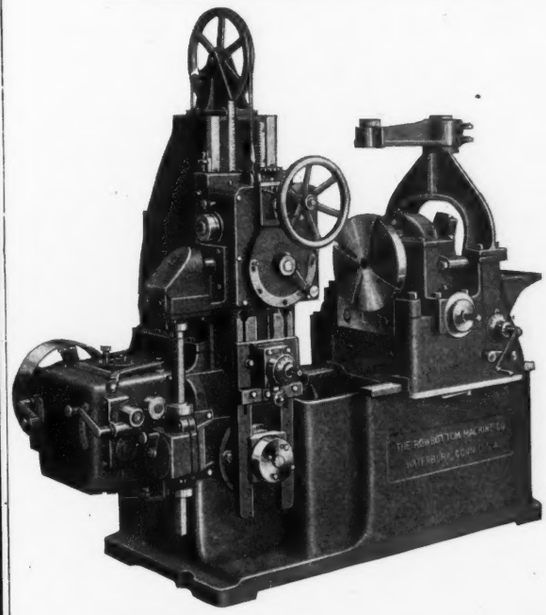
THE WATSON-STILLMAN CO.

192 Fulton St., New York **McCormick Building, Chicago**

Philadelphia, Widener Bldg.

434

Cams! Cams! Cams!



DO YOU MAKE THEM OR BUY THEM?

Either way we can solve your problems. If you cut them in your own plant we recommend the Rowbottom Cam Milling Machine. If you buy them we'll cut them for you on the same machine.

In either case they'll be good cams accurately cut on a thoroughly practical machine built by experienced cam cutters.

Let us tell you more about Rowbottom Cams and Cam Milling Machines.

THE ROWBOTTOM MACHINE CO.

Factory, Waterville, Conn.

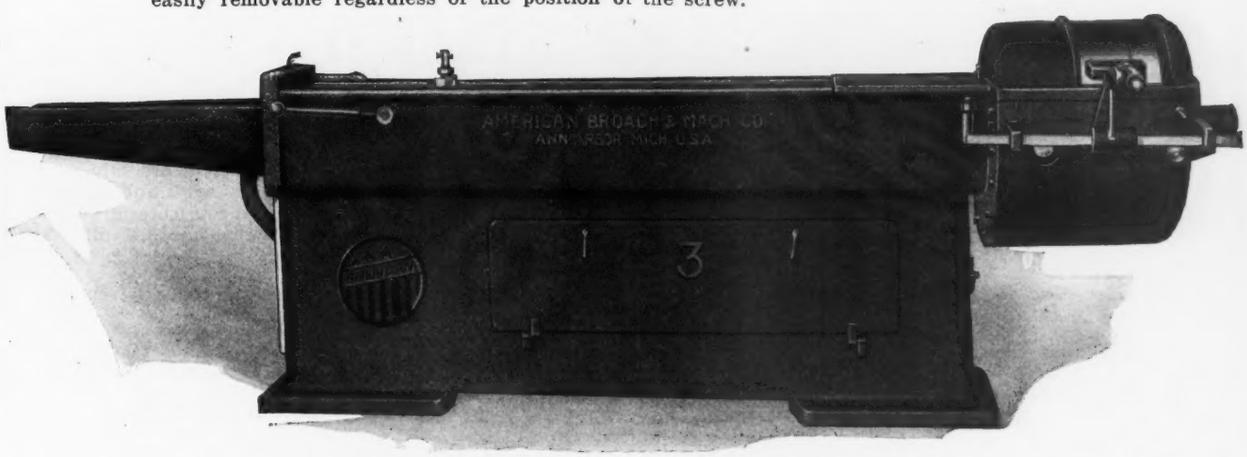
WATERBURY CONNECTICUT

Rowbottom for Cams

American Broaching Machines

Practical Profitable Durable

The cut shows our No. 3 machine—the most recent development in our line. Especially fast; with high speed return stroke, ample lubrication and convenient operating controls. Single belt drive, roller thrust-bearing and nut run in oil in a special compartment, and the nut is easily removable regardless of the position of the screw.

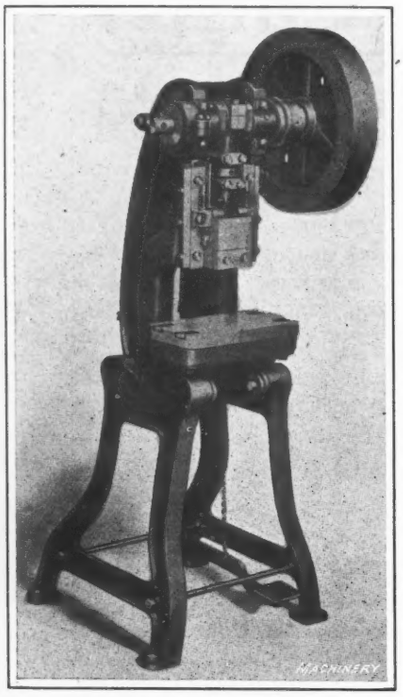


Send for the circular of this efficient Broaching machine.

American Broach & Machine Company, ANN ARBOR MICHIGAN

F. J. LAPOINTE, President and Authority on Broaching

REPRESENTATIVES: Detroit Office, 305 Scherer Bldg., Phone, Cadillac 5381; **Cleveland, O.,** M. Jaeger, 342 Engineers Bldg.; **Toledo, O.,** National Supply Co.; **St. Paul, Minn., Savage & Winter Co.; Belgium,** Henri Benedictus, Brussels; **France,** Louis Besse, 39 Rue De Lappe, Paris; **Finland, Norway** and **Sweden,** Ryland & Aspland, Stockholm, Sweden.



Send for Bulletin 112-IJ which gives detail specifications

Eastern Representative:
57 Transportation Building, Philadelphia, Pa.

THOMAS

Open Back Inclinable

POWER PRESSES

Some of the Reasons for Their Satisfactory Service

Thomas Power Presses are built with more than ordinary care—with unusual accuracy—and each press is operated under belt for several hours to insure the correct adjustment of every working part.

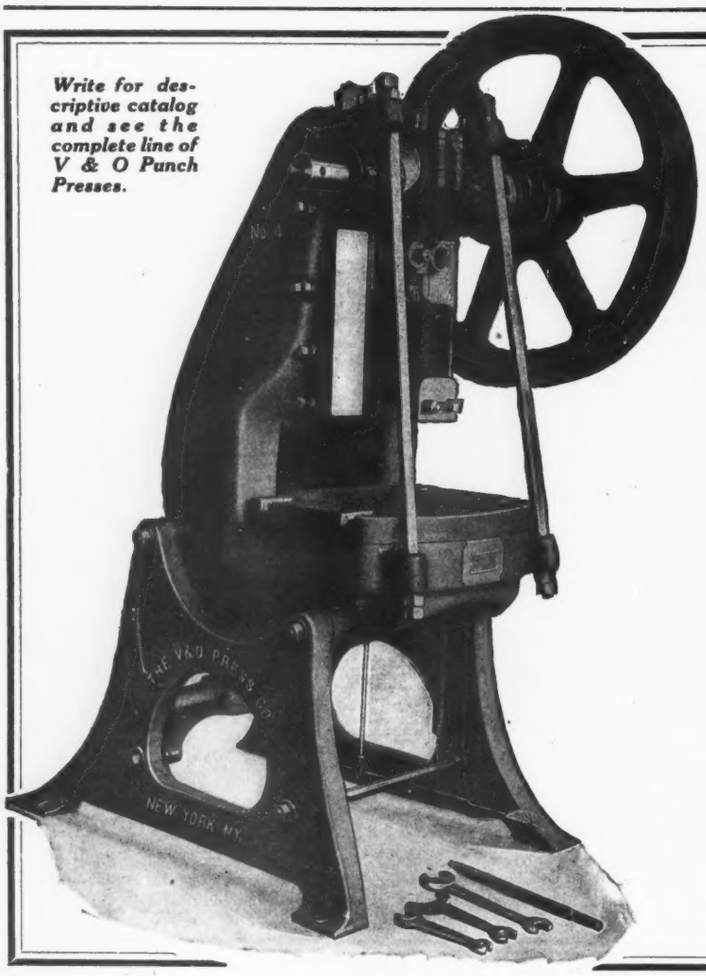
Crank shafts are open hearth steel forgings, heat-treated before finish-grinding.

The Automatic Safety Type of Clutch is furnished on all presses. The patented non-repeat feature makes it safe and convenient for the operator.

A "safety lock" set screw on the clutch block allows him to turn the press over by hand for setting and adjusting dies without danger of the machine being operated accidentally.

THOMAS SPACING MACHINE CO.
Fulton Building **PITTSBURGH, PA.**

Write for descriptive catalog and see the complete line of V & O Punch Presses.



V & O

INCLINABLE

Punch Presses

For Rugged Strength and Absolute Accuracy

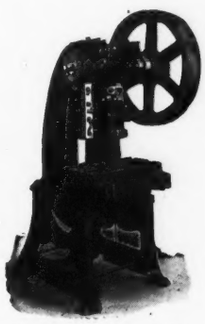
V & O Inclinable Punch Presses are safe, are adapted to a wide variety of work and can be used for practically any sheet material with plain, gang and combination dies of almost every description.

Stock can be fed from right to left, front to back, or vice versa.

V & O "LONG SLIDE" Construction
Cuts die repairs in half.

The V & O Press Co.
100 Dry Harbor Road
GLENDALE BROOKLYN, N. Y.
Presses, Dies, Sheet Metal Working Machinery

Niagara Power Presses



Inclinable Power Press

LET OUR ENGINEERING DEPARTMENT ASSIST YOU WITH YOUR PROBLEMS

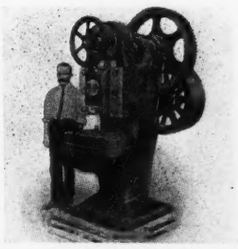
New Edition Press Catalog on Request

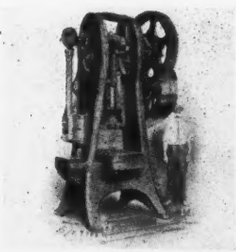


Geared Punching Press

NIAGARA MACHINE & TOOL WORKS

BUFFALO, NEW YORK





FERRACUTE PRESSES

For Cutting, Forming and Drawing Metal

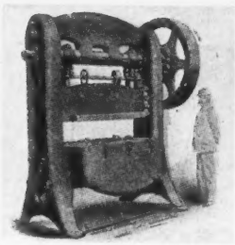
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Ferracute Machine Co.

BRIDGETON, NEW JERSEY





SWAINE



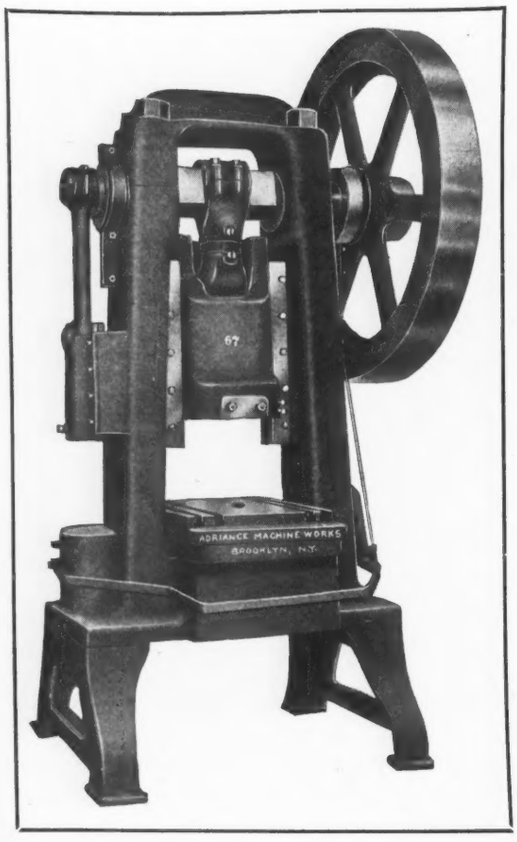
A Practical Geared Punch Press with Slide Adjustable to .001"

Box cap grip holds punch shanks in this as in all other Swaine Presses, and gearing is cut from the solid. Shafts and clutch parts are of vanadium steel. Gear guards, self-oiling devices, box type frame, slide adjustment to .001", and other features insure safety and a powerful, accurate stroke. Full details of this and other Swaine Presses in catalog.

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Largest Press Builders in the West

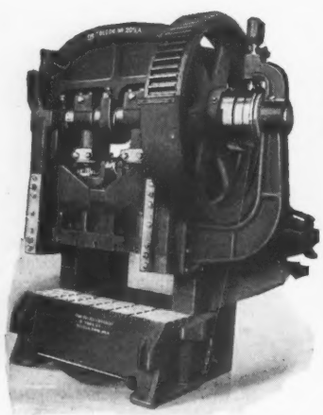


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No. 67 Power Press
Carefully thought out in Every detail of Construction

The Adriance No. 67 Straight-side Power Press has many important details of design not ordinarily met with. Rigidity is assured by four large steel tie bolts running vertically through the press body, bed and crown, bolting all securely together. Wide slides are supported to gibs for almost their entire length when slide is at bottom of stroke. Right- and left-hand screw connections for adjustment of slides are extra heavy. Crankshafts are of forged steel. Write.

ADRIANCE MACHINE WORKS, Inc.
BROOKLYN NEW YORK

THE "TOLEDO"
High Speed Forging Presses



The "Toledo" Forging Press No. 210A. for high speed heavy forging, forming, stamping and embossing.

Have capacity for a recommended speed of not less than 30 strokes per minute so that as many as five or more operations may be performed in succession with but one heating.

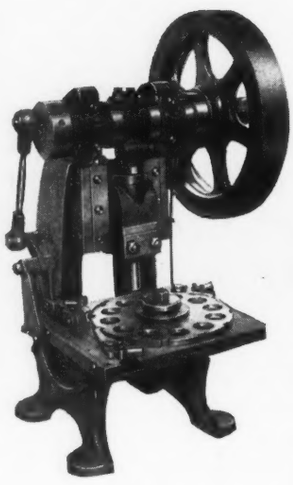
These presses are constructed to withstand the most severe treatment and to stand up under unusually heavy loads.

The Toledo Machine & Tool Co., Toledo, Ohio

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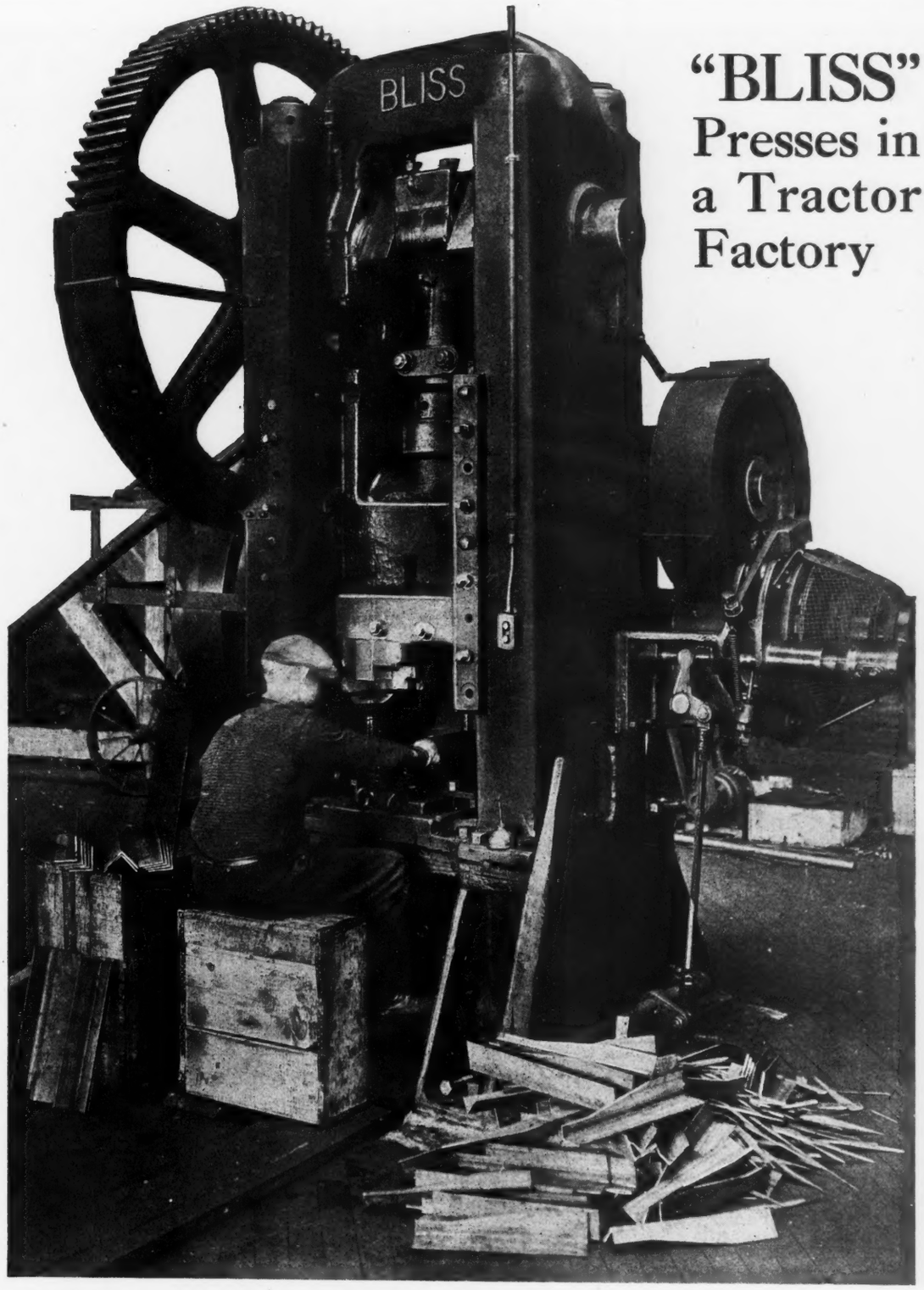
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Furnished to Fit All Sizes and Makes of Presses

We Also Build Acme Roll Feeds Complete With Scrap Cutters and Straightening Rolls

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SUCCESSORS TO
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"BLISS" No. 78½ Straight Side Press trimming angle bars for wheel cleats for the Samson Tractor. An unusual trimming operation.

BLISS 1857

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BY INVITATION MEMBER OF
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"LEATHER SENSE" is that rare quality possessed by some few men in the leather business, that includes judgment, training, and experience, and goes beyond them. No amount of training or experience can give you "leather sense". You either acquire it or you don't, and few have it.

The man has it who is shown inspecting the leather before the center stock is cut out for our Reliance and Sea Lion belting. He not only has "leather sense" but he had eleven years training as a belt maker before he was entrusted with this important work. And when we add to judgment, training, experience, and "leather sense", the inherent honesty of character which is a fundamental requirement of all of our workmen, we know that one more responsibility has been well placed.

Leather belting is peculiarly a product in which the capability and honesty of the men who make and market the belts are all important factors in the finished result. These qualities are basic possessions of the entire personnel of both our manufacturing and sales departments. They are the main reason why Chicago Belting is now regarded as the standard of quality in the field of power transmission by belting

Write for our new 96 page Belting Reference Book and Catalog.

Chicago Belting Company

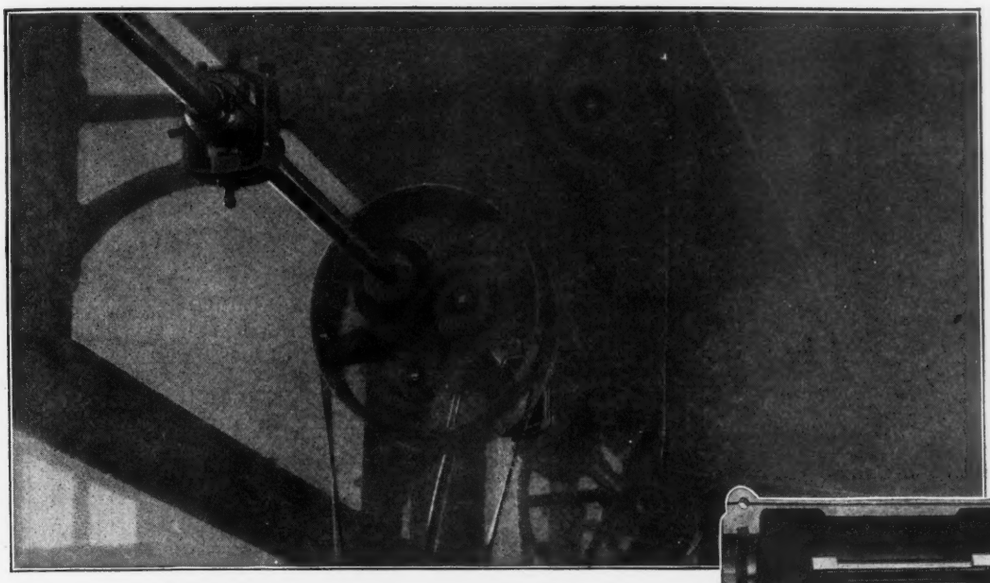
Manufacturers of Leather Belting

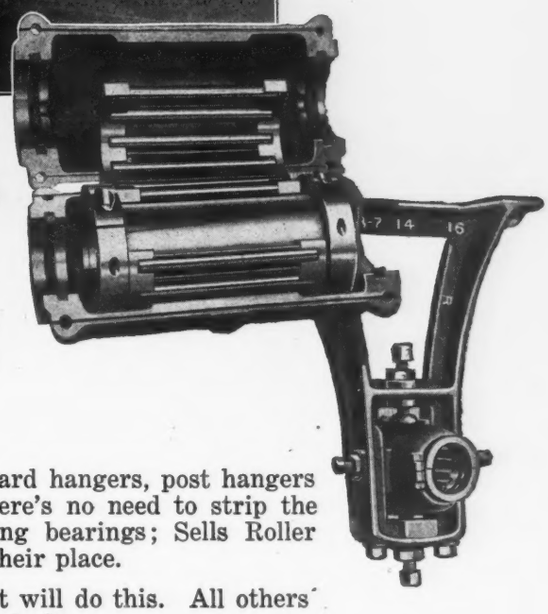
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Chicago Belting





OVERNIGHT

You can substitute Sells Roller Bearings for your power wasting bearings—using your present hanger frames.

Sells Roller Bearings, size for size fit all standard hangers, post hangers and pillow blocks. When you install them there's no need to strip the shafting. Just pull out the old power wasting bearings; Sells Roller Bearings are split throughout and fit right in their place.

The Sells is the only bearing, roller or ball, that will do this. All others require new hangers or blocks, or stripping the shafts.

Also your shaft is protected from wear by the high carbon split sleeve of the Sells Roller Bearing. It fits over the soft shaft. The rollers bear against it, also against a similar high carbon steel surface inside the box. Sells Roller Bearings are full floating; there can be no end thrust. Neither can there be roller-against-roller friction, for the rollers are retained snugly in a cage and kept apart. Both rollers and cage revolve with the shaft.

Let us tell you all about Sells Roller Bearings. Then you'll appreciate why such concerns as Dodge Bros., The United Shoe Machinery Company, Aunt Jemima Mills Company, The American Car and Foundry Company, The Gillette Safety Razor Company and other nationally known concerns have adopted them.

A post card brings our book on anti-friction bearings.

John D. Sells
MANAGER

ROYERSFORD FOUNDRY & MACHINE COMPANY

54 North Fifth Street **PHILADELPHIA, PENNA.**

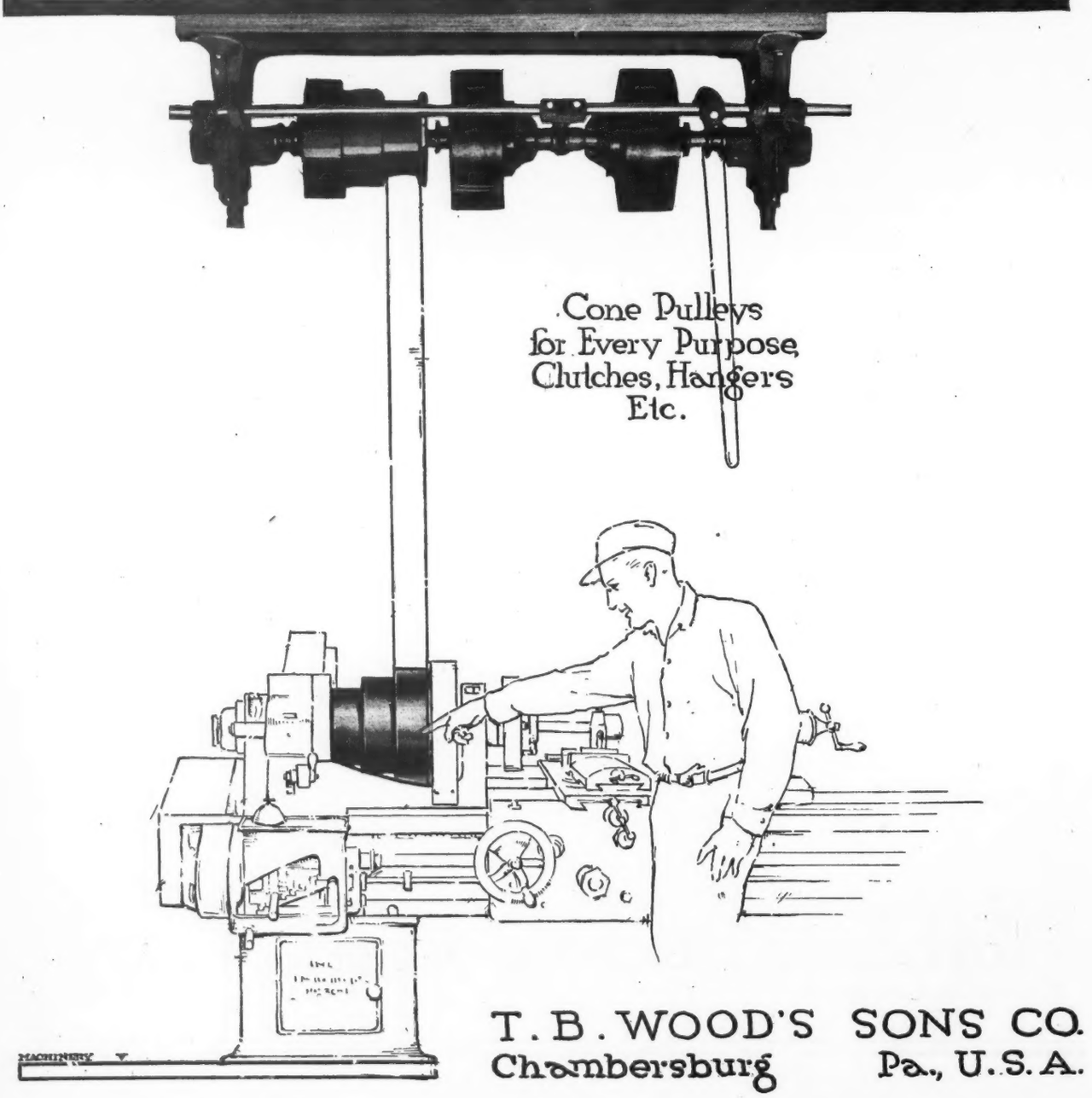
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Power Transmission Appliances

We've been specialists in this line for 63 years—experimenting, expanding and improving. Though we have limited ourselves exclusively to the one class of service, our line includes every item even remotely connected with transmitting power from generator to tool-spindle, even cone-pulleys for lathes, milling machines, etc.

Machine tool builders who use them agree that these parts are as much improved by "specialization" as bearings, spindles, clutches and other parts of their machines which they no longer attempt to make for themselves.

They find, also, that a complete T. B. Woods unit—countershaft, clutch and cone pulley complete—is a profitable "feature" to incorporate in high grade belt driven mechanisms. Send for our latest Catalog, it illustrates the most complete line of POWER TRANSMISSION APPLIANCES.



Cone Pulleys
for Every Purpose
Clutches, Hangers
Etc.

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A Shepard Traveling Crane rolls along its tracks—day in, day out there is no variation. After years of service it will be found as dependable as the day it was installed.

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Shepard Electric Traveling Cranes are made in capacities of 1 to 50 tons; Electric Hoists, ½ to 30 tons.

Engineers of wide experience will gladly assist you in planning the right type of equipment for any plant. Their services are extended without obligation on your part.

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Member Electric Hoist Manufacturers' Assn.
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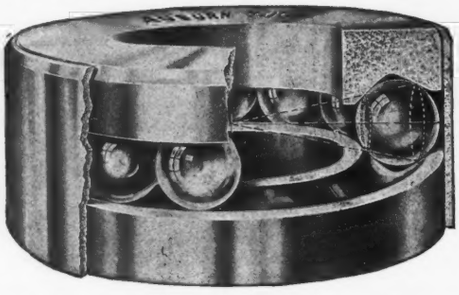
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ELECTRIC CRANES & HOISTS

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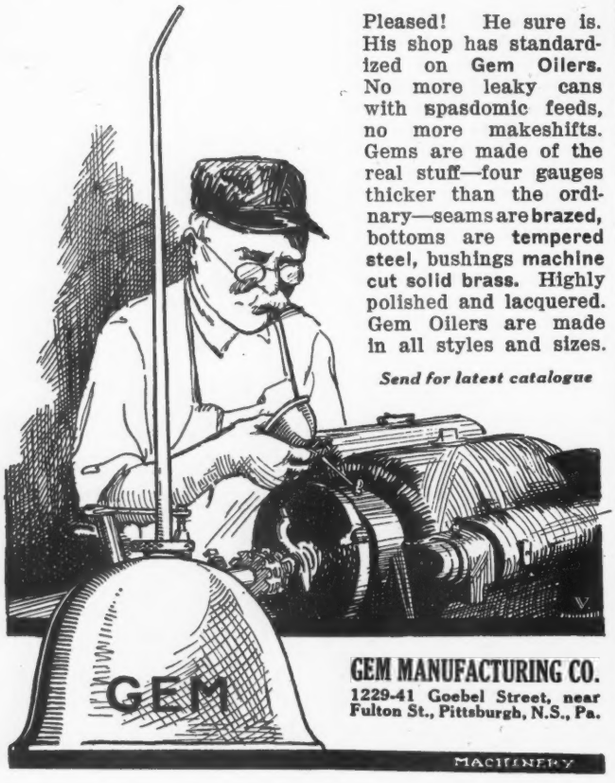




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Pleased! He sure is. His shop has standardized on **Gem Oilers.** No more leaky cans with spasdomic feeds, no more makeshifts. Gems are made of the real stuff—four gauges thicker than the ordinary—seams are **brazed,** bottoms are **tempered steel,** bushings **machine cut solid brass.** Highly polished and lacquered. Gem Oilers are made in all styles and sizes.

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MICHAUD Safety Lathe Dogs

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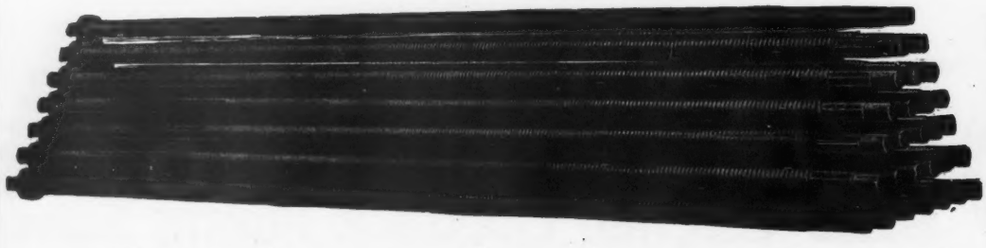
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Recently a manufacturer who had stopped buying Arguto Oilless Bearings because he could buy a cheaper oilless bearing, came back to Arguto with this comment:—

"Our chief engineer says he has had all sorts of bearings submitted, but could not find any other oilless bearing as good as Arguto.

"We have tried every other oilless bearing on the market in careful tests, and our chief engineer is so positive in his report that we are again going to put our bearing problems in your hands."

Back of Arguto Oilless Bearings is a jealously guarded principle of sound materials properly treated, true and accurate workmanship. That is why we are continuously hearing from the users of Arguto Oilless Bearings.

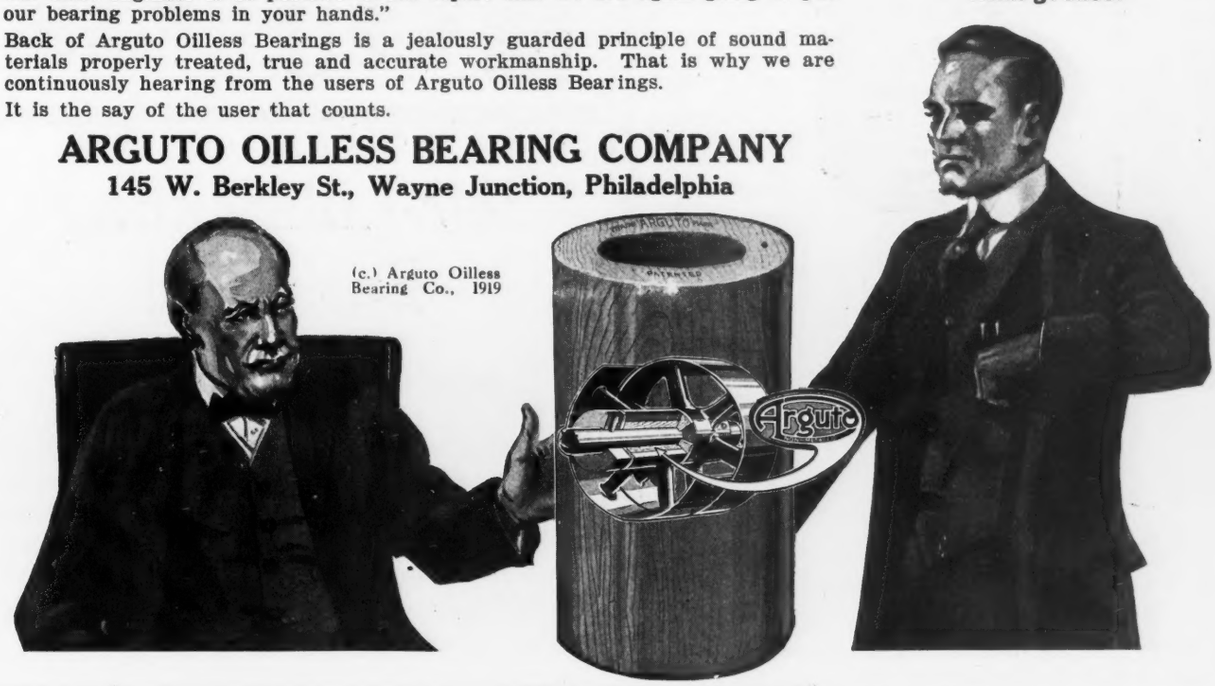
It is the say of the user that counts.

Outwears the best bronze.

Smoother than grease.

ARGUTO OILLESS BEARING COMPANY

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THE only time a Safety Set Screw is expensive, is when it's so cheap that it reams or mushrooms in the hole.

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Undeniably, the price of a *broached* hollow screw should be lower than the cold-drawn ALLEN. But the broached screw is never so low-costing in *use.*

The ALLEN is made by a patented process of cold-drawing, which increases the density of the steel around the socket-hole, and *adds to the strength of the screw 30 %.*

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The sockets are clean and perfectly-formed down to the bottom—and this extra depth, with the 30% extra strength of the sockets, is ample prevention against reaming, bursting or mushrooming.

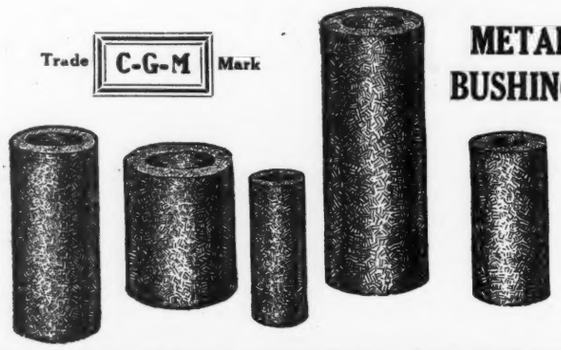
The process is more expensive than broaching—*for us.* It is less expensive for you. The new Allen booklet shows *why;* may we send you copy?

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125 Sheldon St., Hartford, Conn.

Pacific Coast Branch Office: The Charles A. Dowd Sales Co., 320 Market St., San Francisco, Calif.

Trade C-G-M Mark

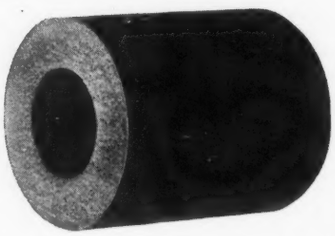
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Self-Lubricating Bushings!

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SUPPOSE that you had on hand when your first tap was broken a commercial device built especially to remove the broken pieces of tap, a commercial device not a home-made article, would you not have saved a great deal of time?

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Seats are bronze to bronze, cannot rust or corrode. Accurately fitted, strong, durable. Price list and sample union on request. Write now.

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The Fairbanks Co., Sales Agents. Canadian Factory: Dart Union Co., Ltd., Toronto



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WILLSON GOGGLES

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Flexible Steel Tubing

for cutting-tool lubricant. "Wheelock" tubing is most flexible, oil tight, durable. Try it on your machines. Low priced. ⅛-, ¼-, ⅜- and ½-in. sizes. Send for samples.

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Machine tool handles that fit the hand

The workman who operates a machine tool eight hours a day appreciates a good machine tool handle. It makes his work easier—it aids production.

Back of "Cincinnati" Machine Tool Handles are 33 years of handle making experience for the leading machine tool builders.

These handles are made from the finest screw stock, neatly turned, and then finely buffed and polished.

Moreover, we can supply you with "Cincinnati" Machine Tool Handles for less than you can make them yourself.

Our large reserve stocks of all sizes and styles insure you immediate shipment.

Write.

The Cincinnati Ball Crank Co.

DETROIT CINCINNATI



The "Cincinnati" Compression Coupling

The "Cincinnati" Compression Coupling has just five parts—two rings and three longitudinal sections.

The three longitudinal sections grip the two ends of the shaftings, while the rings hold them on tightly.

Installation of this coupling takes about ten minutes—and you have a connection that will last for years.

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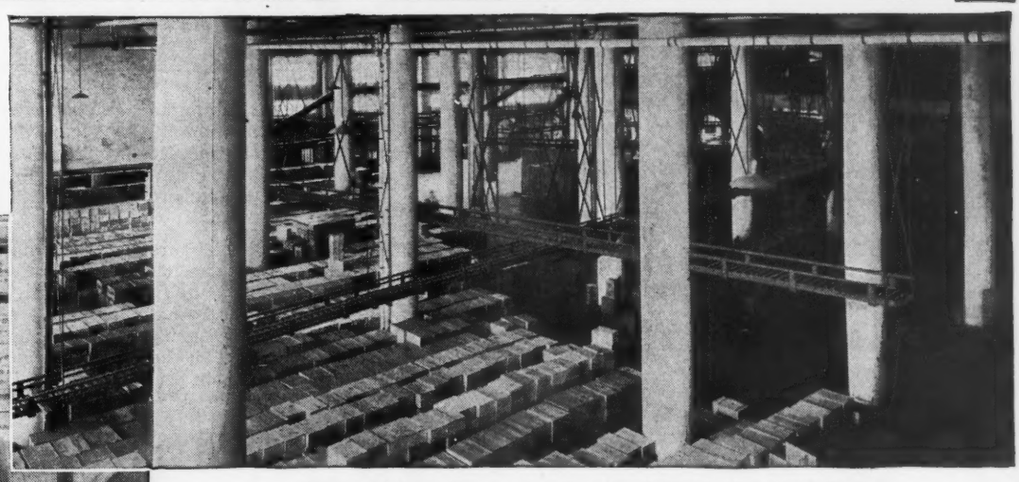
A PAYING INVESTMENT

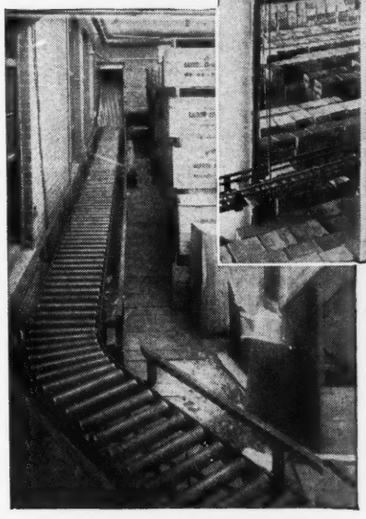


If you were told that a new make of automobile truck had been placed on the market at an acceptable price and which was guaranteed by responsible parties to last a specified length of time longer than the ordinary type, wouldn't it look like a pretty good investment?

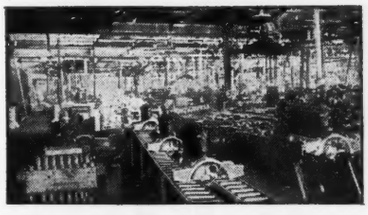
Today, cranes and presses are driven with the greatest satisfaction, not by the ordinary type of gear made of cast steel, but by Nuttall B. P. treated gears ***which are guaranteed to last four times as long as standard cast-steel gears in identical service.***

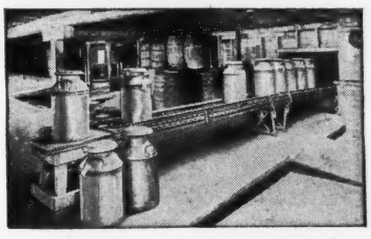
R. D. NUTTALL COMPANY
PITTSBURGH, PA.

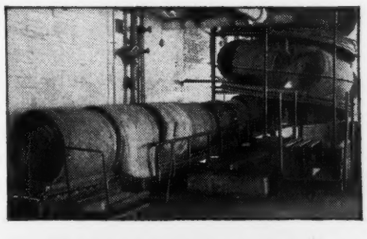




With a Mathews Conveyer system the California Associated Raisin Company can fill or empty this warehouse in one-fourth the time and with one-fourth the labor it would require to do it by wheeling, trucking or carrying. And note the floor space saved! Mathews Conveyers are just as practical in your line of business—indoors or out.









One Big Labor Problem Solved

YOU can't cut down productive labor without cutting down production. But you can cut down handling labor and thereby actually *increase* production. Here's how:

Convey by Gravity—to and from cars, floor to floor, operation to operation, warehouse to shipping platform, etc. Gravity conveying speeds up production by keeping the lines of supply and output open; hands busy; machines "fed".

Gravity costs nothing—draws no pay; consumes no fuel. Gravity reports every morning; no hands short. Gravity stays on the job; lives forever and never goes on strike. Gravity works most anywhere and carries most anything—boxes or bales, barrels or buckets, bundles or bags, cases or crates, cartons or cans, lumber or bricks, castings or pig, etc.

Gravity conveying saves in a way that can be plainly seen—in smaller payrolls, lower costs, greater production. Look into it. A letter or postcard brings further information and, if desired, a nearby Mathews branch sales engineer qualified and glad to discuss your particular problems. No obligation.

Mathews systems are the most thorough exponents of gravity conveying on the market. They are engineered systems. Each is specially adapted to the requirements of the business, plant, layout, handling routes of the concern it is to serve. Portable single units for light work, short hauls, etc.

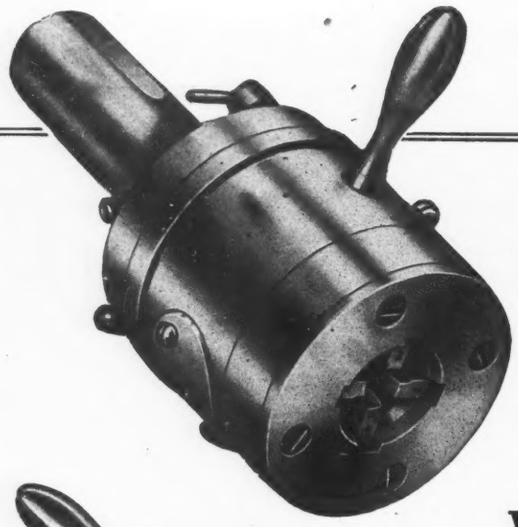
Patented drawn-steel, ball-bearing rollers balanced true and shaped to hold objects to their course. Special rollers for brick and tile, bundled shingles, etc.

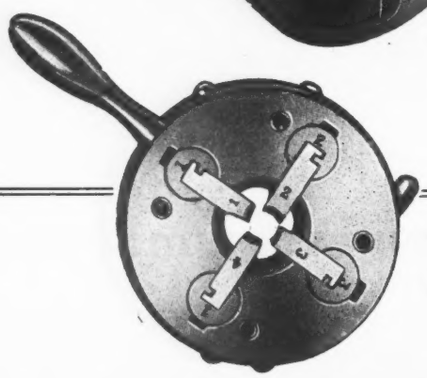
MATHEWS GRAVITY CARRIER CO.
144 Tenth Street, Ellwood City, Pa.

Branch Factories:
Port Hope, Ontario London, England

Member of Material Handling Machinery Manufacturers Association

MATHEWS
SPEED ECONOMY
GRAVITY ROLLER CONVEYER





SEE IT?

Foremost in the ranks of modern thread cutting equipment stands the Victor Self-opening and Adjustable Die Head. Troubles met with in tools of its type have been done away with, and maximum efficiency assured with a minimum of attention.

Has individual plungers set at an angle of 14.5° which support the chasers at a corresponding angle. Slots in the latter fit into a tongue milled in the former. Plungers are securely held in a collar insuring simultaneous action in opening or closing head. Bearing is given chasers along their entire length—THEY CANNOT TILT AND CUT TAPERED THREADS.

VICTOR DIE HEAD

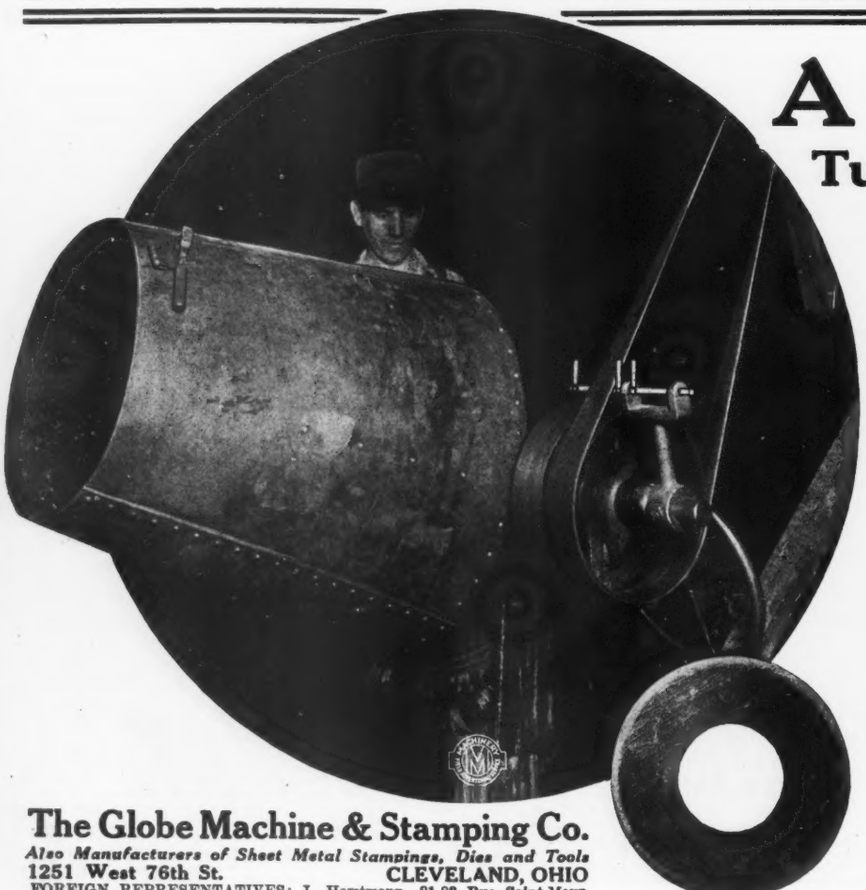
SELF-OPENING—ADJUSTABLE

SEND FOR EXPLANATORY BOOKLET TODAY

VICTOR TOOL COMPANY

WAYNESBORO PENNA.

REPRESENTATIVES: New England, O. H. Lorange, Boston. Michigan, Firmhill Machine Supply Company, Detroit. Illinois and Wisconsin, Eugene Goller & Co., Chicago. Indiana, Thomson Tool and Supply Co., Indianapolis, Philadelphia, Swind Machinery Co. Cleveland, A. H. Howard Sales Engr. Co. Cincinnati, Gang Machinery Co.



A GLOBE
Tumbling Barrel

Cleaning and Burring Washers for the Nash Motor Co.

For one year this GLOBE Tumbling Barrel has been in service at the Nash Motor plant, Kenosha, Wis., where it is used for the cleaning and "burring" of washers. The foreman of the Press Department (where this machine is installed) says that the GLOBE Tumbling Barrel has given them excellent results. To finish a barrel of work takes from fifteen minutes to an hour, depending upon the condition of the work—by this is meant, how much "flash" and "burrs" must be removed.

Let us show you what a GLOBE Tumbling Barrel will do for you.

The Globe Machine & Stamping Co.

Also Manufacturers of Sheet Metal Stampings, Dies and Tools

1251 West 76th St. CLEVELAND, OHIO

FOREIGN REPRESENTATIVES: J. Horstmann, 81-83 Rue Saint-Maur, Paris, France; 46 Rue Juliette-Recamier, Lyons, France.

ADJUSTABLE TAPER CALIPER

QUALITY K. T. W. TOOLS



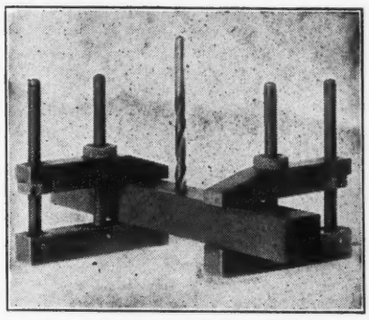
Easily adjusted, always accurate, insures duplication of tapered parts



High Speed Parallel Clamps

Stand firmly and hold work truly parallel. Durable and convenient.

Circulars?



KNAUEL TOOL WORKS

Rock Island Illinois

Rieker Levels Talk

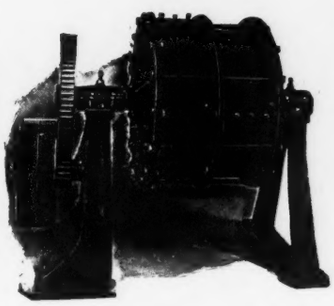
In the same language as the micrometer. The vial is graduated in thousandths, and each graduation indicates 1/1000 out of level per foot of length of machine being leveled. Rugged yet precise. Made in several styles. Send for circular.



RIEKER INSTRUMENT CO.

Manufacturers of Scientific Instruments

1919-1921 Fairmont Ave., Philadelphia, Pa.



Polishing Economy

The "Abbott" Burnishing Barrel is the last word in "polishing economy"—it is a machine that eliminates skilled labor from the polishing department. One man or a boy can operate four or five machines. We will burnish a sample of your work free and give you an estimate of time and cost. Write us today.

THE ABBOTT BALL COMPANY

ELMWOOD, HARTFORD, CONN., U. S. A.

Speed Up "Turnover" on Machine Investments

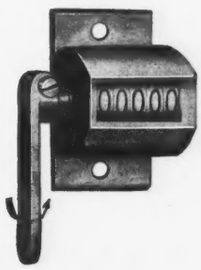
This is a time to turn over quickly the money invested in machines; get out the goods and get in the money; cut down the time of production.

The man at the machine should know what is rightfully to be expected of him in speed and amount of output.

Any machine worth investing in at all is worth equipping with a

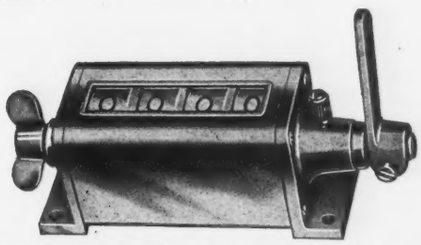
Veeder COUNTER

—to record its production, speed up its operator and make it a quicker *dividend-payer.*



This small **Rotary Ratchet Counter** (No. 6) counts reciprocating movements of the lever, as required in recording the product of punch presses. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. A complete revolution of the lever registers ten. This counter is adaptable to no end of small machines, simply by regulating the throw of the lever. Price, $2.00. *Cut nearly full size.*

The **Revolution Set-back Counter** below is designed for the larger machines where a shaft-revolution indicates an operation.



Registers one for each revolution of shaft, and sets back to zero from any figure by turning knob once round. Supplied with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $10.00 (List). (*Cut ½ size*)

Write for new booklet showing counters for every possible application.

The Veeder Mfg. Co.

39 Sargeant Street, Hartford, Conn.

Middle West Distributor:
Carey G. Wirick & Co.,
564 W. Randolph St.,
Chicago, Ill.

Pacific Coast Distributor:
F. Somers Peterson Co.,
57 California St.,
San Francisco, Cal.

SaBeN-KERAU

The Super High Speed Steel

SaBeN-KERAU is in demand where the finest grade of High Speed Steel is appreciated—

Because for one and one-half centuries its makers have been reputation building;

Because quality has never been sacrificed to tonnage, and

Because the same conscientious care with all the modern resources of test, analysis and research is devoted to every bar of steel.

MANUFACTURED BY

SANDERSON BROS. & NEWBOULD, Ltd.

ESTABLISHED 1776 SHEFFIELD, ENG.

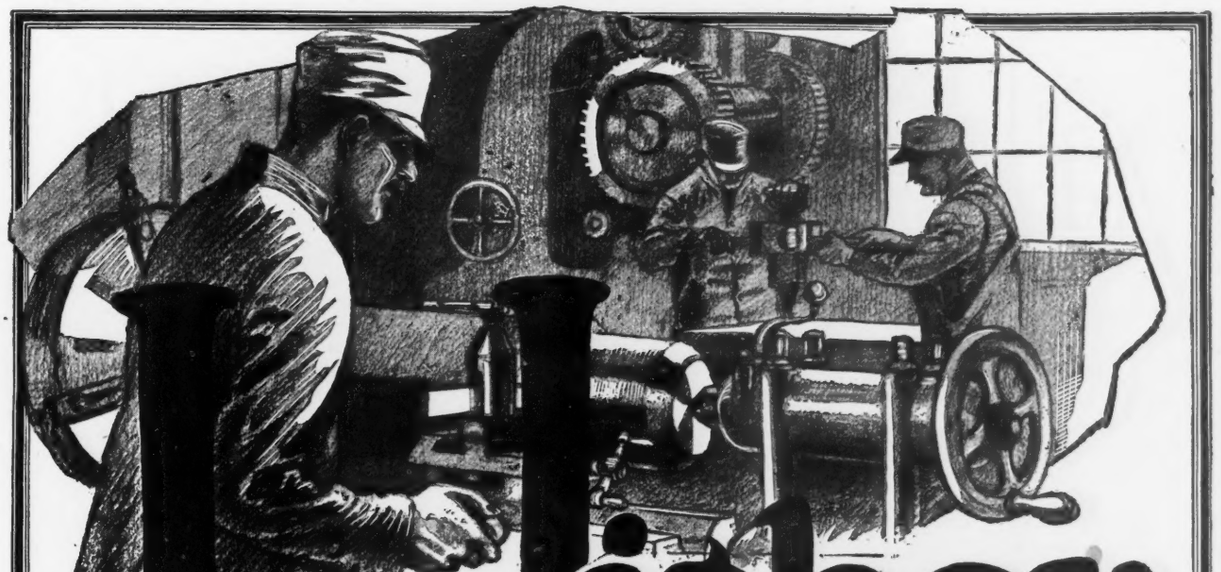
"Made as well as Steel can be made"

ROBERT K. GREAVES AND COMPANY

549 West Washington Boulevard

DETROIT CHICAGO NEW YORK

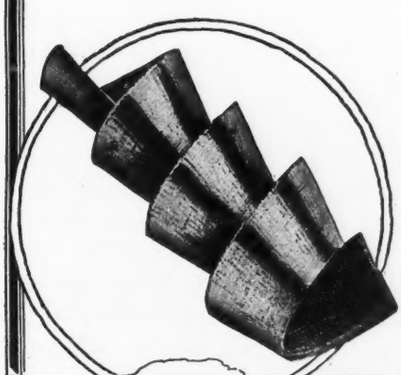
SOLE AGENTS FOR THE U. S. A.



Higher speed at any depth of cut

Here's a Shaving—

The measurements of this small shaving are: 13 inches long, three-fourths of an inch wide, $\frac{3}{8}$ to $\frac{7}{16}$ inches thick at butt. The shaving was made from an axle forging of 25 per cent. carbon steel, and is *the last of a twenty-hour run with the same Stellite tool.*



BECAUSE tools of Stellite will specifically and actually do more work, and do it cheaper than tools of any other metal or alloy, they are of interest to every manufacturer who seeks *increased production* and a *decreased cost* per unit.

Stellite tools are made for high speed. Stellite is harder than the hardest steel, and this hardness is inherent.

Stellite is not a tempered metal. Tools of Stellite are immune to heat up to 1800 F. Up to this point *the hotter they get the better they cut.* It follows that higher speed at any depth of cut is assured with a corresponding decrease in manufacturing costs, in other words *greater production at less cost.*

HAYNES STELLITE CO., KOKOMO, INDIANA
CARBIDE & CARBON BLDG., 30 EAST 42ND STREET, N. Y. C.



UNION DRAWN SERVICE

Bright Finished Steel

Quality, Variety, and Delivery Unexcelled



Main Mill, Beaver Falls, Pa.



Mill, Gary, Indiana

WE specialize in Cold Drawn, Turned and Polished Shafting and Elevator Guides, Free Cutting Screw Stock, Squares, Flats, Hexagons and Special Cold Drawn Shapes—Best Bright Bessemer, O. H. Alloy and Electric Steels.

Write for Quotations



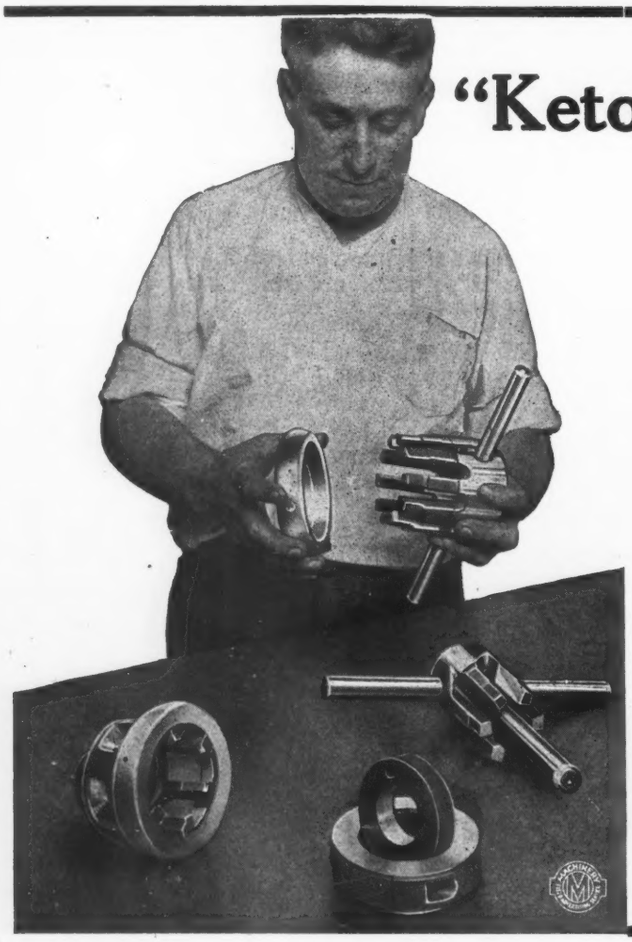
Mill No 2, Beaver Falls, Pa.

Union Drawn Steel Co. Main Office: **Beaver Falls, Pa.**

WORKS: Beaver Falls, Pa. and Gary, Ind,

Other Offices and Warehouses—New York, 460-466 Washington St. Philadelphia Ninth and Willow Sts. Cincinnati, Spring Grove Ave. Chicago 570 West Adams St. Detroit, 69 Jos. Campau Ave.
Sales Offices—Boston, 95 Milk St.; Buffalo, White Building, Cleveland, Rockefeller Building.

"Ketos" Exclusively Here



This photo was taken in one of America's leading airplane factories, where exhaustive experiments have proved "Ketos" the best steel for expanding taps, thread and ring gages and other special tools that must hold their shape through heat-treatment.

It hardens uniformly, without shrinkage or distortion, and is an excellent substitute for high speed steel at an appreciable saving in cost—as many manufacturers have proved by experience, die-makers being particularly enthusiastic about it. Try it in your toolroom.

Hawkridge Brothers Company

303 CONGRESS ST. BOSTON, MASS.



A Big Thing in Ball Bearings

UNIFORM carbonizing and case-hardening are paramount to the success of any ball-bearing. Because of their non-oxidizing properties Cast Nichrome Retorts and other heat-treating containers permit the heat to penetrate readily and uniformly. Heats are shorter and fuel consumption is less for the same reason. Cast Nichrome Containers last for thousands of hours at 1800° F. without warping, cracking or scaling. Economy is doubly assured by the Nichrome guarantee: Cast Nichrome Heat-treating Containers for every purpose—

Manufactured under HENDERSON Patents by

Rotary Retorts of Cast Nichrome

DRIVER-HARRIS COMPANY
HARRISON, N.J.

CANADIAN WORKS
CANADIAN DRIVER-HARRIS CO.
WALKERVILLE, ONT. CANADA

CHICAGO
28 So. JEFFERSON ST.

DETROIT
514 FREE PRESS BLDG.

BRITISH WORKS
DRIVER, DRENNAN & COOPER,
MANCHESTER, ENGLAND

ENDURE IN HIGH TEMPERATURE

Besly Taps Are Well Appreciated in Making Agricultural Tools



For five years Besly Taps have been used exclusively in the William E. Pratt Mfg. Co.'s factory at Joliet, Ill., for tapping malleable iron clevis castings for plows, wagons and other agricultural tools. A specially designed four-spindle machine is used and three clevises are run on the tap shank, which is removed and replaced without stopping the machine.

These castings are particularly mean to tap, as there is apt to be sand in them; but the superintendent says that Besly Taps "stand up better than any others."



Big Output Per Day and Between Grinds

When photographed the machine was tapping $1\frac{9}{32}$"—12 holes, with all four taps working at once, and turning out 750 per spindle per day—3000 from the whole machine. One tap threads 1500 clevises—2 days' work—between grinds.

Charles H. Besly & Company
120-B No. Clinton St. Chicago, Ill.





Better Than The Average Drills

OBVIOUSLY, the drill that stands the test is the drill which is made with the greatest measure of care and precision.

Celfor Drills are made with a view to standing tests. Their makers forsee the stress, the punishment to which they will be subjected.

They recognize the probability of human error. They are aware of the fact that in using the small motor-driven drill, a man cannot continue to bore exactly on a vertical plane. Fatigue compels him to occasionally drive on the bias.

This especially on the deeper holes, is what tells on a drill.

The grain of Celfor Drills is uninterrupted by milling. They are forged. Their flutes are twisted into the high speed steel while at white heat; they are cooled properly and well, so that only tough, wear-resisting, fibrous steel remains, which is deprived of its brittleness by a soft core.

A book called "Putting Mettle in Metal" tells you more about the qualities of Celfor Drills. It will be sent to you on request.

CLARK EQUIPMENT COMPANY

Buchanan, Michigan

Foreign Representatives

Montreal, Rudel-Belnap Machinery Co.; Toronto, Rudel-Belnap Machinery Co.; Amsterdam, U. S. Trading Corp.; Buenos Aires, Marden, Orth & Hastings Co.; Calcutta, Tapper & Selikowitz; Christiania, John M. Larsen; Copenhagen, John M. Larsen; Gothenberg, John M. Larsen; Stockholm, John M. Larsen; London, Coates Machinery Tool Co.; Milan, Weiss & Stabilini; Tokio, Andrews & George; Paris, Moerch & Roumet.

macitalks
or
Set Screw Sermons
No. 4



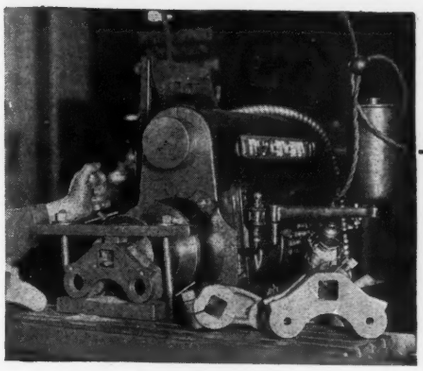
mac-it



BRANCHES
Boston
New York
Philadelphia
Pittsburgh
Detroit
Chicago

Just as a tack can puncture a tire, a set-screw which goes wrong can tie up an expensive machine or a whole department. There are few worse places for careless buying than on set-screws.

THE STRONG, CARLISLE & HAMMOND COMPANY
CLEVELAND
(MAKE MAC-IT ENDURANCE YOUR BEST INSURANCE)

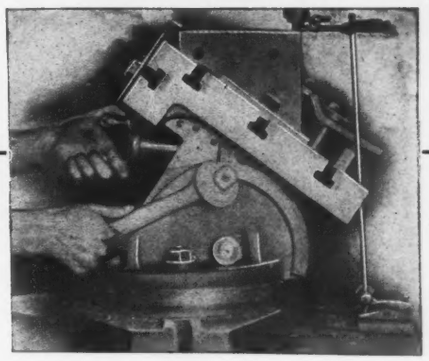


Can You Use SQUARE HOLES?

Many industries are now using square holes in their manufacturing processes, but many more have been unable to do so because there has not been on the market a device for quickly, cheaply and accurately producing them. With the

Radbore Head

it is possible to *drill* square holes and produce a finished job in a single operation. Holes may be drilled in sizes ranging from ⅛" up to 2" in diameter, to any depth or blind with absolutely flat bottoms, and with a twist drill. There is no vibration, and while in operation the drill always maintains alignment by a 4-point bearing, thus giving positive action. The holes can be drilled in any substance, out of whole material, in a single operation, and without previous preparation or subsequent finishing.



Nelson Angle Fixture

The Nelson Fixture and Angle Plate is the only fixture which provides a second face and T-slot. Here are some of the exclusive features:

Complete absence of overhang in any position.

Low and compact.

Vertical adjustment up to 90 degrees by means of a handle operating a worm-wheel sector, the design of which has been worked out in such a way that dirt or chips cannot become lodged in the machine.

Location of T-slots allow for powerful clamping without disturbing the most accurate setting.

Swivel base graduated up to 360 degrees; swivel for tilting tables graduated up to 90 degrees.

Absolute rigidity and stability.

Zero adjustment on horizontal plane.

THESE two devices, sold exclusively by the Fairbanks Company, are fast becoming essentials in every up-to-date machine shop. They are designed scientifically and therefore do their work more quickly and produce more accurate work at a lower cost.

Besides these and other special devices, the Fairbanks Company also sells a complete line of machine tools and machinist's and machine shop equipment. The pooled stock of 24 branch houses is at your disposal, the consequently enormous purchasing power assures a fair price, and the FAIRBANKS O. K. is your guarantee over all. *Send for descriptive literature.*

The FAIRBANKS *Company*

Albany	Boston	Chicago	Hartford	New York	Pittsburgh	Scranton	Tulsa
Baltimore	Bridgeport	Cleveland	Newark	Paterson	Providence	St. Louis	Utica
Birmingham	Buffalo	Detroit	New Orleans	Philadelphia	Rochester	Syracuse	Washington

Havana Kingston London Birmingham Glasgow Paris

Administrative Offices: New York

FAIRBANKS O.K.

Fairbanks Scales, Trucks and Wheelbarrows, Valves, Engines and Pumps, Power Transmission; Mill, Mine and Railway Supplies, Automobile Repair Equipment, Lincoln Electric Motors, Steel Factory Equipment.



The Bell-Like Ring of One Solid Metal

Bronze-Back Bearings

Suspend a Stewart Bearing by a cord and tap it with a hammer. The surprisingly clear bell-like ring proves the unity of the bronze backing with the babbitt lining. These two parts are so inseparably united that disintegration is practically impossible.

Stewart Bearings are designed for use in automotive equipment, transmission machinery, electric motors and generators, as well as special machinery involving unusual problems of load or lubrication.

Let Stewart engineers work with your own engineering department in designing a special bronze-back bearing that will be best for your product.

Stewart Manufacturing Corporation
4500 Fullerton Avenue, Chicago

Stewart

FIRTH-STERLINGISM

is the doctrine of the human element in steel making and tool making, a just tribute to the man at the fire and the man at the machine. Efficiency and capacity in tools are in proportion to the character put into the work.

Steel and tools have character just as men have character. All character, human and metallic, is developed by natural processes. There must be enough friction, but not too much. There must be enough work, but not too much. Claims for tool steel or advertisements which eliminate the man and the human element of coöperation have a depressing effect on personal ambition and this effect means failure. The mechanic has pride in his job just as the president has pride in his job. Both have responsibility and both need encouragement.

Nothing is more helpless than a bar of steel. Alone it can do nothing. It leans against the wall of a blacksmith shop awaiting man's skill and the heat of the forge to call it to work and action. The human element of determination makes steel tools cut metals; the human element of determination makes steel ships cut the seas.

No first-rate tool was ever made in a hurry except by accident. Time is required for honest work. A thoughtful tool dresser will measure aright the value of time in heating steel. The design of a tool is more important than the temper, but every good tool must have both. Proper designing and proper forging are important, tempering to suit the work is important, the grinding is important, but all these may be right and the tool fail by improper use. Firth-Sterlingism recognizes that credit to all is the spirit of the age; including the man that designs, the man that forges, the man that tempers, the man that grinds and the man that uses the tool, all coöperating for success and profit to the man that pays the bills. There is a capacity in a well-made tool that defies analysis because it is part of the man himself. The mission of a bar of steel has only begun when it is delivered to the buyer. At that point the seller's responsibility ceases and the buyer's responsibility begins. The outcome is beyond the control and responsibility of the maker of the steel. Superiority in steel is a fact. All steel is not alike. There is more in steel than chemists can find. Good steel came before laboratories. Good bread came before cook-books. Good blacksmiths and good mechanics came before printing presses.

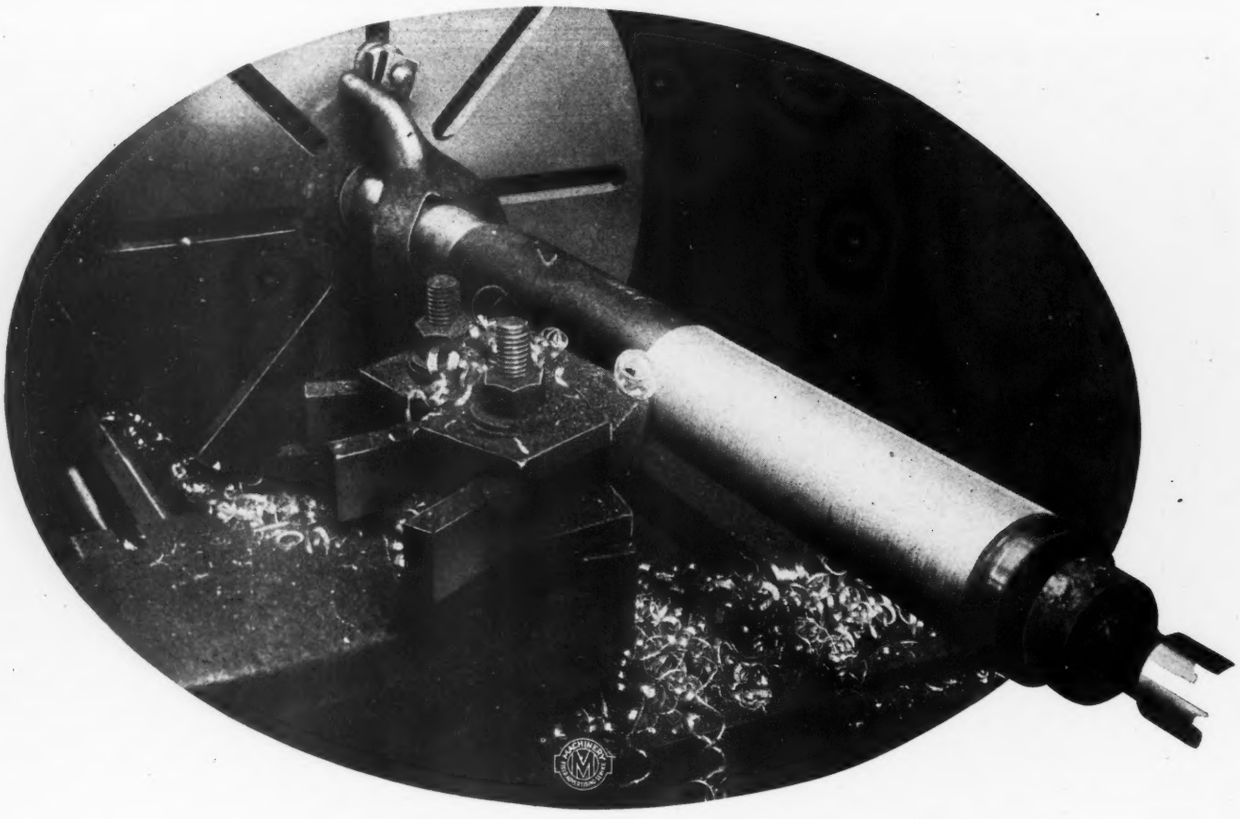
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FIRTH-STERLING STEEL COMPANY

High Grade Tool Steel For Every Purpose

McKeesport, Pa.

NEW YORK BOSTON PHILADELPHIA CLEVELAND
PITTSBURGH CHICAGO



A Unique Set Up Made Possible by the Cutting Qualities of

Electrite Uranium Tools

Though there are three Electrite Uranium Tools shown in this photograph only two are used in each operation.

This manufacturer cuts the non-productive time in manufacturing rear axle tubings by arranging his tools to cut on both the forward and reverse movement of the carriage. The first and center tools take the cut on the forward movement—a new tube is inserted and the third and center tools come into operation on the return. This time-saving method of handling this job is aided by the cutting qualities of the tools—all of Electrite Uranium.

Try Electrite Uranium Cutting Tools. They pay.

LESCO

Use Lesco Steels for every purpose. Tell us which one you need.

LATROBE ELECTRIC STEEL CO.

Latrobe **Pa., U. S. A.**

BRANCH OFFICES:

New York, N. Y. 165 Broadway.
Chicago, Ill. 572 West Randolph St.
Detroit, Mich. 344-46 Rivard Street.
Pittsburgh, Pa. 610 Union Building.
Cleveland, O. 1st National Bank Bldg.
Cincinnati, O. 2802 Union Central Bldg.
Toledo, O. 248 Water Street.
Erie, Pa. 15th and Ash Streets.
Philadelphia, Pa. 303 Finance Bldg.
Washington, D. C. Commercial Nat'l Bank Bldg.
San Francisco, Cal. 149 California St.
Los Angeles, Cal. American Bank Bldg.
Seattle, Washington Coleman Building.
Buffalo, N. Y. 278 Delaware Ave.



THE man who tempers a BILLINGS & SPENCER die performs a task of infinite delicacy. He builds high character into steel. His craft goes beyond mere knowledge—it is work no machine can perform, no instrument gauge. The rightness of the Triangle B die passes inevitably to the Triangle B forging. In steel, as in men, character begets character.



Produced in the United States

Have you ever stopped to consider that Molybdenum is the *only* "commercial steel alloying element" produced in the United States in sufficient quantities to take care of our growing domestic industries?

In fact, the world's chief source of supply lies right in the town of Climax, Colorado.

Thus is the American steel industry assured of a continuous supply under *any conditions.*

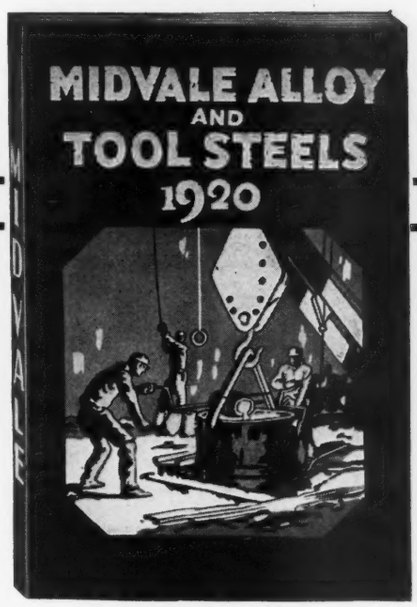
The superior commercial properties of the Molybdenum Steels are completely set forth in our book, "Molybdenum Commercial Steels," which will be sent upon application to

Climax Molybdenum Co.
or
The American Metal Co., Ltd.
61 Broadway, New York

Molybdenum Steels

Easier to Heat Treat
Easier to Machine

Dynamically Tougher
Resist Fatigue—



A HANDBOOK, *not merely a Catalog*

MIDVALE ALLOY AND TOOL STEELS

has been one of our most popular publications because it not only tells what steel to use, but the proper methods of handling, treating, and the results that can be obtained. A unique and successful feature is the inclusion of a set of curves showing the critical temperatures and physical properties of all the steels listed. Do you have a copy? If not, our nearest district office will be pleased to supply you with one.

MIDVALE STEEL AND ORDNANCE COMPANY
CAMBRIA STEEL COMPANY

General Sales Office, WIDENER BUILDING, PHILADELPHIA, PA.

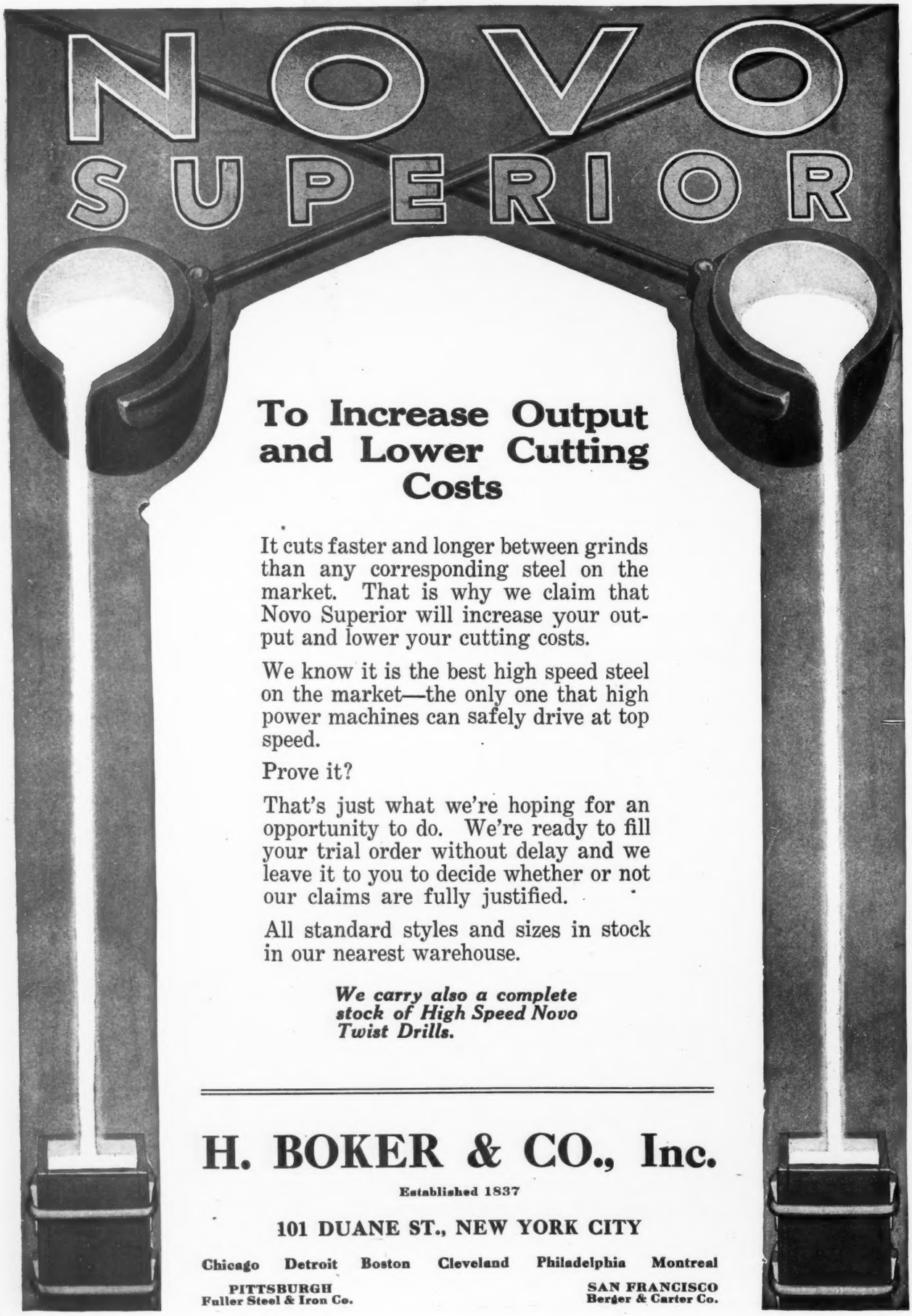
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SOLE EXPORT REPRESENTATIVE

CONSOLIDATED STEEL CORPORATION, 165 Broadway, New York.
All export inquiries should be sent to this address.

Series Number 2-O



To Increase Output and Lower Cutting Costs

It cuts faster and longer between grinds than any corresponding steel on the market. That is why we claim that Novo Superior will increase your output and lower your cutting costs.

We know it is the best high speed steel on the market—the only one that high power machines can safely drive at top speed.

Prove it?

That's just what we're hoping for an opportunity to do. We're ready to fill your trial order without delay and we leave it to you to decide whether or not our claims are fully justified.

All standard styles and sizes in stock in our nearest warehouse.

We carry also a complete stock of High Speed Novo Twist Drills.

H. BOKER & CO., Inc.

Established 1837

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"the master drawing pencil"

Use a 2H, 3H or HB Dixon's Eldorado for making simple detailed drawings. The final result is eloquent proof of the quality of this master drawing pencil.

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Write to us on your letterhead, tell us the kind of work you do, and we will mail you full-length free samples of the pencils best suited to your particular needs. Also write for interesting free booklet—"FINDING YOUR PENCIL."

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PENCIL DEPT. 74-J, JERSEY CITY, N. J.

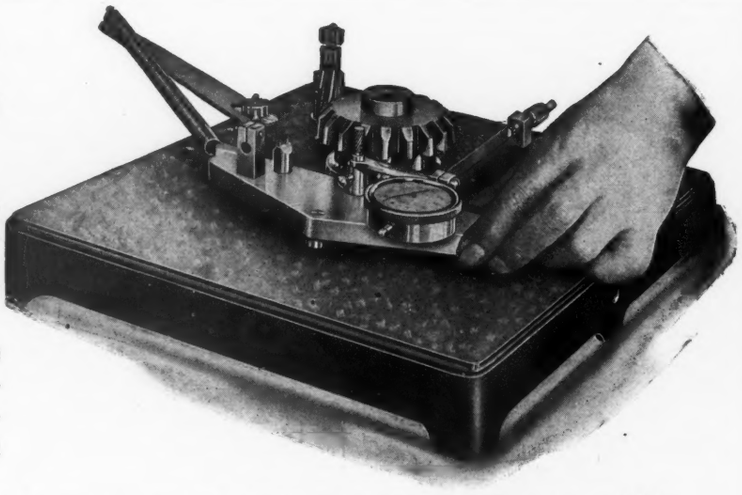
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DIXON'S ELDORADO is made in 17 leads—one for every need or preference

KAVLE

Correct Involute Contour Indicator



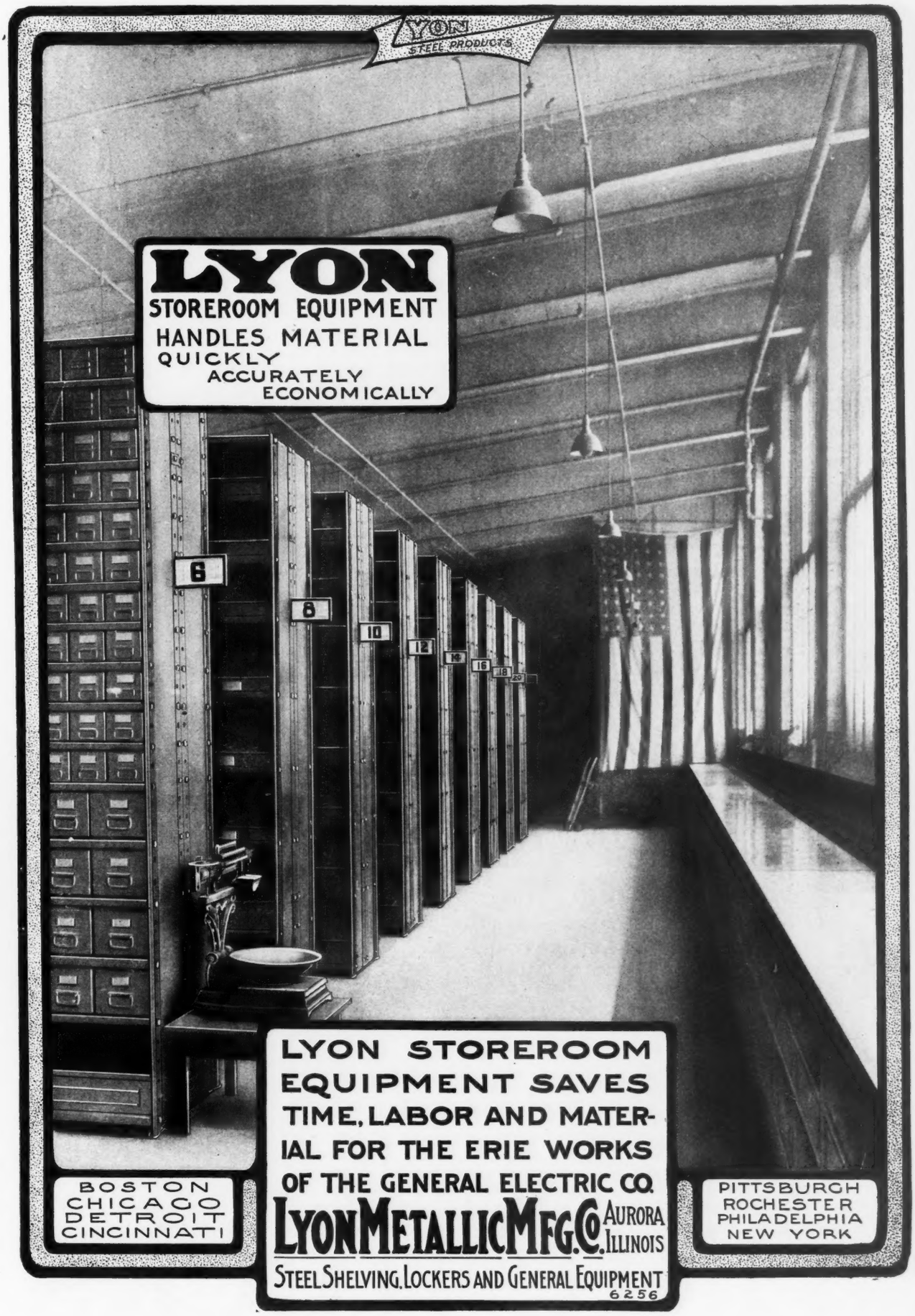
You are interested in Quiet, Long Lived Gears.

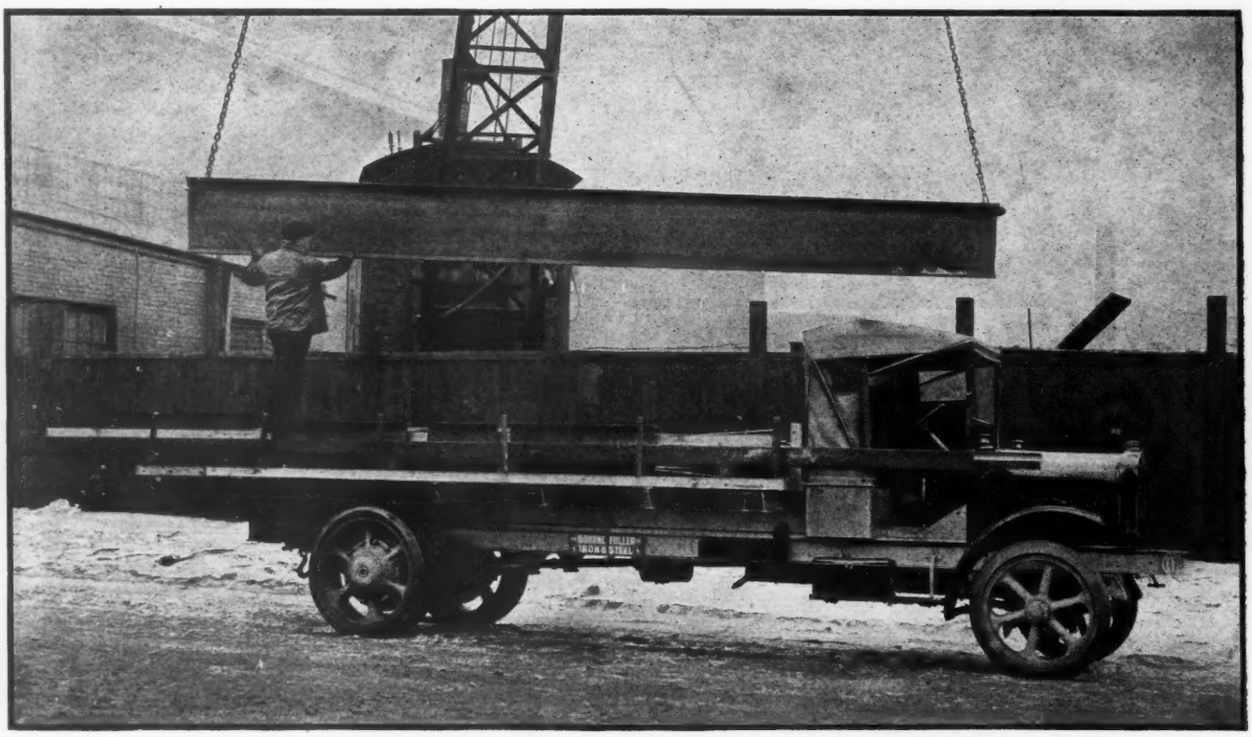
Therefore, you will welcome "KAVLE CORRECT INVOLUTE CONTOUR INDICATOR"—a newcomer in the shop.

This indicator will indicate the accuracy of contour and indexing to within .0002" by direct reading on the indicator dial.

One of the largest transmission manufacturers in America made this statement: "Before indicating our gears with the 'Kavle Correct Involute Contour Indicator' it was necessary to assemble, test, dissemble and reassemble 60 per cent of our transmissions in order to obtain quietness. By assembling gears which passed inspection by the use of this gauge, this dissembling and reassembling was reduced to 2 per cent. The noise from this 2 per cent was found to arise from other sources than the gears."

MANUFACTURERS' CONSULTING ENGINEERS
SYRACUSE **NEW YORK, U. S. A.**


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LYON STOREROOM EQUIPMENT SAVES TIME, LABOR AND MATERIAL FOR THE ERIE WORKS OF THE GENERAL ELECTRIC CO.
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One of a fleet of 8 Whites owned by The Bourne-Fuller Co., of Cleveland

The MOST WORK *for the* LEAST MONEY

THE Bourne-Fuller Co., of Cleveland, has had seven years' experience with White Trucks. Cost records have shown this owner that Whites last longer, do more work, and cost less to operate and maintain.

Evidence of this fact is shown in the comparative records of a 5-ton White and a 5-ton truck of another high-grade make doing similar work, kept during a period of a year. Summarized, these records show that:

The cost per mile traveled was 22 per cent less for the White than for the other truck.

The cost per ton hauled was 13 per cent less for the White.

The White gave 30 per cent greater mileage per gallon of gasoline.

The repair cost on the White was 17 per cent less than on the other truck; the White ran 8450 miles, the other truck only 6820 miles.

It is through such records as this that the White's reputation for economy has been so unquestionably established. The most experienced truck users increase their White equipment steadily because White Trucks steadily do the most work for the least money.

THE WHITE COMPANY
CLEVELAND

White Trucks



Distinguished For Excellence of Design

"New Britain" Tote Box Racks are real space and time savers. Especially valuable for stock and assembling room use, but may be employed in many different capacities in various parts of your plant.

Simple in design, light in weight; they are strong and rigid enough to withstand any weight with which they may be loaded. Racks are made to accommodate 16" x 10" x 5" or 20" x 12" x 6" boxes, and can be furnished in height and length to suit individual requirements.

"NEW BRITAIN"
Tote Boxes and Tote Box Racks

"New Britain" Tote Boxes represent a radical departure from previous tote box design. The shaped-for-comfort handle; the unique nesting and stacking features; the greater capacity for withstanding abuse without loss of shape—due to formed hem and firmly welded joints; a construction affording maximum strength with minimum weight—all combine to produce boxes of unusual merit, a quite general recognition of which has resulted in their widespread adoption as the standard equipment in hundreds of factories.



We are confident a trial would make you a steady user. Prompt shipment can be made! How many?

The New Britain Machine Company

New Britain, Conn. U.S.A.



GISHOLT

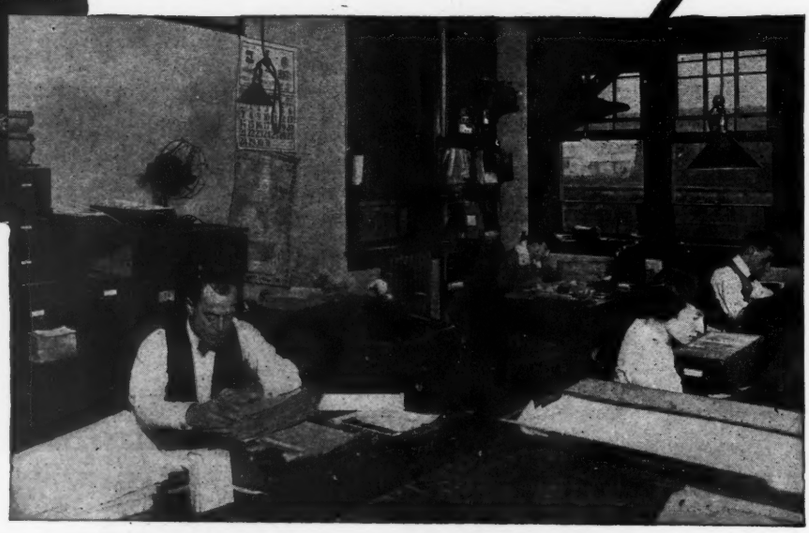
From Shop to Cost Department



Periodograph time tickets carry their message of truth regarding time spent on jobs.

From workman to cost clerk the process of registering time, planning work and computing costs is simplified.

Let a Gisholt salesman trace the course of a Periodograph time ticket through your plant and show you how it will help your production.



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An organization of lubrication specialists

SUN OILS

The Sun Company—one of the world's largest producers, refiners and shippers of oil products—has specialized on lubrication for a quarter century. Its output of lubricating oils alone exceeds a million and a quarter gallons per week.

From its very beginning, the Sun Company has aimed to furnish accurate and efficient lubrication rather than just "oil." It has become an organization of lubrication experts.

The choice of oil for any particular service demands expert advice. Manufacturers and big users of lubricants can no more afford to buy oil except on a basis of its lubricating efficiency than they can afford to buy coal other than on a basis of its thermal units.

Engineers and experts of the Sun Company are always available to make a thorough analysis of your lubrication requirement and submit recommendations. This service is free, and will be promptly and cheerfully performed on application to any branch office of the company.

Manufacturers using cutting oils should not fail to read our announcements to follow regarding the Sun Cutting Lubricants. They include Sun Emulso, Sun Automatic Cutting Oil and Sun Pipe Threading Oil.

These lubricants are not just so many more "oils." Tests under every condition of service have shown extraordinary results in lubrication and refrigeration. They have set new standards.

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The money you get from the junk man will pay for enough Texaco Crater Compound to keep him away for a *long, long time*

Texaco Crater Compound saves the gears.

It is a rich heavy lubricant and coats each tooth with a film of lubricant that stays put. So that when tooth meets tooth on "Crater" lubricated gears there is no clash, no wear, no noise, for this great lubricant takes up the impact which the metal would otherwise receive.

Then, too—Crater lasts a long time, for besides being highly adhesive, Crater is waterproof. Water or even chemicals will not wash off Crater. You can use it on chain belts, wire ropes, etc.

For all gears enclosed in oil tight cases use "Crater's" little brother, Texaco Thuban Compound.

Get a supply—Start saving gears

THE TEXAS COMPANY

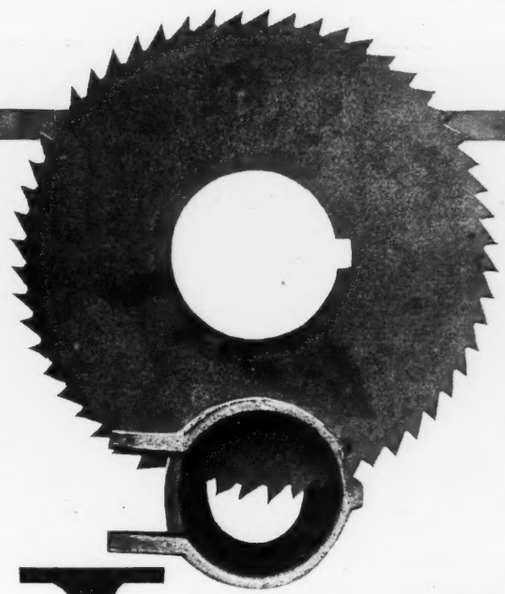
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There is a Texaco Lubricant for Every Purpose



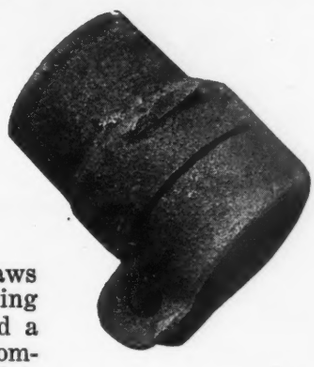
They Couldn't Find A Saw to Stand up to the Work--

Until They Tried

LINCOLN

HIGH SPEED SCREW SLOTTING CUTTERS

Now
Read What They Have to Say







" . . . we had difficulty procuring saws that would stand up to the work of sawing malleable iron castings until we received a shipment from the Lincoln Twist Drill Company. From the first, these H. S. Screw Slotting Cutters have been used steadily; there is very little variation in them; they combine toughness with the right degree of hardness, and their lasting qualities are better than in any other saws that we have been able to purchase for this work."

Quoted from a letter written May 18, 1920, by one of the largest manufacturers of electrical equipment in the metropolitan district (name on request).

Will you give us your opinion of these saws? Try them.

LINCOLN TWIST DRILL CO.

Taunton **Mass., U.S.A.**

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STOCO

SAFETY GOGGLES

"CELOGLAS"

SHATTER-PROOF LENS

STOCO Safety Goggles because of their broad smooth surfaces bearing on the face and their remarkably light weight—when their strength and durability are considered—may be worn for hours at a stretch without discomfort.

This feature coupled with the fact that they protect between the eyes makes STOCO Safety Goggles—when equipped with Celoglas Shatter-Proof Lenses—the ideal protection glass for wear by operators on chipping and similar work where the eye hazard is high and continuous.

We are always glad to send a sample STOCO Safety Goggle without charge to interested responsible people on receipt of request on letterhead.

STOCO SAFETY GOGGLES

Price Per Hundred (F. O. B. Geneva, N. Y.)

With Celoglas Shatter-Proof Lenses	**$115.00**
With Optical Glass Lenses	**90.00**

Adjustable black elastic headbands or easy cable temples at the same price. Discounts for quantity orders.

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GENEVA, N.Y. U.S.A.


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By means of our up-to-the-minute equipment and highly skilled workmen we are enabled to build into our tools the highest quality and longest service. We know your wants and can fill them.
Send us your inquiries regarding our
Thread Gauges, Deming Indicators and Thread Lead Checking Instruments
The SHEFFIELD MACHINE & TOOL CO., Dayton, Ohio

better holes fewer dollars

CRITCHLEY SUPER EXPANSION IMPROVED SIX REAMER

"They've pulled me out of some bad holes."

They'll do the same for you. A complete set of Critchley Improved SUPER-SIX Expansion Reamers will ream any hole from 15/32" to 4 1/16" as accurately as you can gage it with a "mike"

The unusually large range of expansion of SUPER-SIX Reamers makes them mighty handy for the repair shop. The 15/32" SUPER-SIX, for instance, expands to 17/32", while the 15/16" reamer has an expansion of 1/8 of an inch. You can ream any hole from 15/16" to 1 1/16" with just that one reamer.



Besides, SUPER-SIXES will expand — without forcing — from .010 to .015 of an inch over their rated maximum size, allowing them to be reground again and again before new blades are needed.

This feature, together with the low first cost of the reamers, makes it worth your while in dollars and cents to look for the SUPER-SIX trade mark.

Cutter & Wood Supply Co.
73 PEARL STREET
BOSTON 9, MASS.

USE SUPER-SIX EXPANSION REAMERS



Proper grinding is **absolutely necessary** to insure the accuracy and cutting efficiency of a reamer. We shall be glad to send free upon request complete instructions and diagram for regrinding reamers. Just write and say, "Send me regrinding instructions and descriptive price list of Critchley Improved SUPER-SIX Expansion Reamers."



TRANSPORTATION and NATIONAL PROGRESS are Allied Terms

The welfare of all depends largely upon adequate and efficient TRANSPORTATION. In building new equipment and repairing the old few tools play as important a part as do HIGH SPEED DRILLS AND REAMERS.

Latrobe
High Speed Drills & Reamers

Are long-lived Tools, built not only for accuracy and speed, but to withstand shock and strain. **Latrobe** DRILLS AND REAMERS are the American Standard of Perfection and Efficiency wherever QUALITY in Tools is recognized.

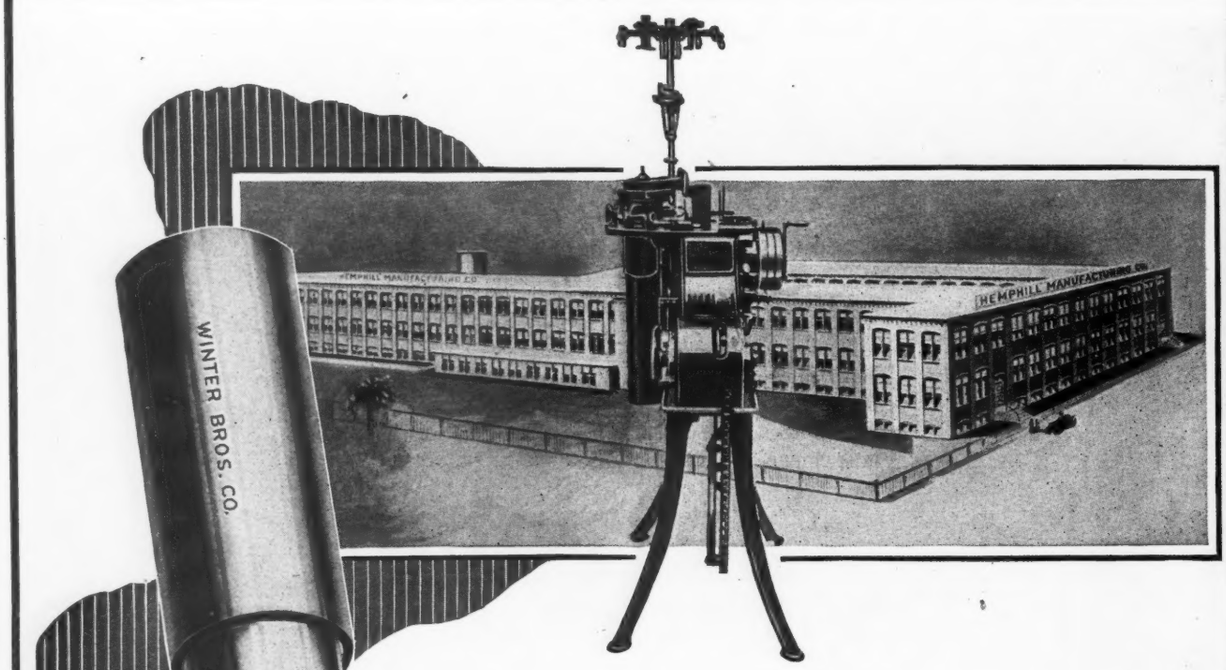
Look for this mark (HIGH LATROBE SPEED) *on the shank.*

LATROBE TOOL COMPANY

MANUFACTURERS

Latrobe - - Penna.

WRITE FOR CATALOGUE





Banner Automatic Knitting Machines Are Built Down in Pawtucket—*and with*

THISTLE BRAND TAPS

"We are pleased to advise you we have been using Winter Brothers' Taps for several years. We cannot recommend them too highly as they are giving us entire satisfaction in every respect"—John Lawson, Pres. & Mgr. Hemphill Company, Pawtucket, R. I.

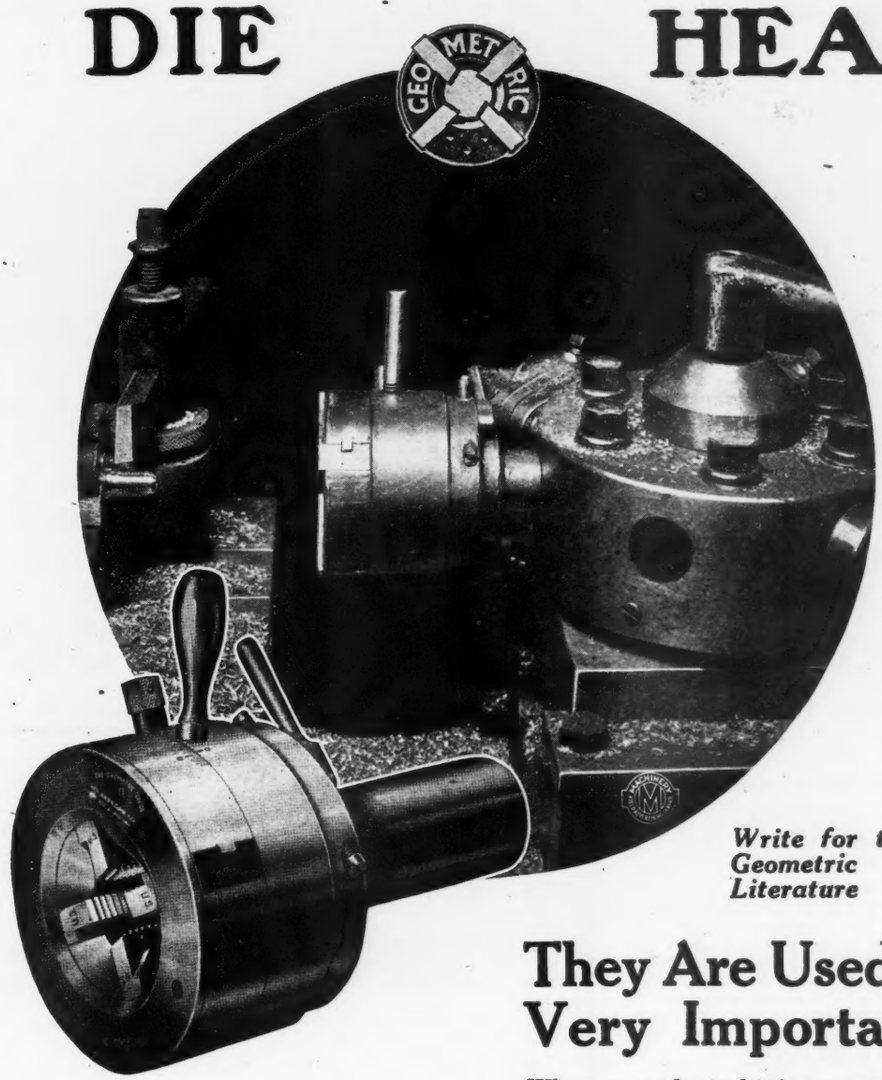
Nothing qualified about this expression of opinion. Yet it's typical of the testimony of all users of Thistle Brand Taps.

Purchasing agents are requested to observe that No. 13 is the only valid edition of our catalog. Yours correct?

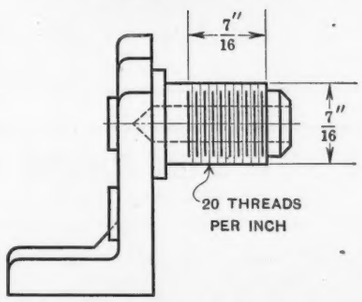
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GEOMETRIC
DIE HEADS



Write for the Geometric Literature



They Are Used Here for Very Important Work

When a product obtains a world-wide reputation, is adopted everywhere in the best known plants, it is sure to be worth a tryout at least.

Six years ago the National Gage & Equipment Company, LaCrosse, Wis., seeking better, quicker, more accurate threading methods, tried out Geometric Die Heads, now a full installation is kept continually busy—they met every need.

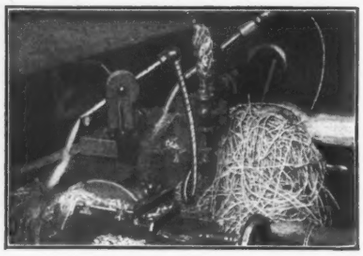
The photograph shows a Geometric Die Head used for threading brass automobile air gage sockets.

THE GEOMETRIC TOOL COMPANY

NEW HAVEN **Chicago Office: 627 W. Washington Blvd.** **CONNECTICUT**

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Performance Talks Loudest

When you buy a cutting oil, buy it for what it has done in the past—not for what it promises to do in the future. Performance is the thing that counts.

Because of its remarkable efficiency—extending over a long period of years—you have the positive assurance, before you use a single drop, that you will get uniformly satisfactory service from

LARCUL CUTTING OILS

Many of the largest and most important machine shops in the country are using Larcul, and we are told that the results are even better than with lard oil.

LARCUL AMBER CUTTING OIL

On account of its transparent quality, Amber Larcul has a distinct advantage in work that must be kept constantly under the operator's eyes.

We recommend Larcul Amber on all types of automatic machines, turret machines, gear cutters, hobbing machines, etc., for high carbon, vanadium, chrome nickel and tungsten steel.

LARCUL EBONY CUTTING OIL

Identical with Larcul Amber in cutting characteristics. Particularly efficient for pipe threading, bolt threading, nut tapping, on turret machines running on high and low carbon and alloy steels, and on automatic machines for forming, turning, boring, threading, etc.

Let us Give You a Demonstration

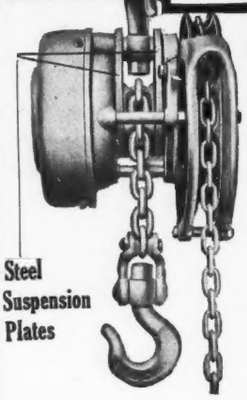
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NEW YORK

Quality Lubricants Since 1853

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SCIENTIFIC LUBRICANTS for SCIENTIFIC LUBRICATION.

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The Block With Safety Built Into It

LIFTING an unusually heavy forging and placing it in a lathe for machining will severely tax the strength of a chain block.

Ordinary cast suspension members might break under the strain. But the steel suspension plates of the Yale Spur-geared Block *safely* carry the load.

The economy of the speedy and powerful Yale Chain Block or Electric Hoist, makes it the first choice of the careful buyer.

Yale Chain Blocks are carried in stock by all representative supply houses. Our new Hoist Catalog explains the details. Write for it.

For a Factory Locking Equipment
Use a Yale Master Key System.

The Yale & Towne Mfg. Co.
Makers of the Yale Locks
Stamford Connecticut

SPUR-GEARED BLOCK



Simple, Quick, Efficient

Stops handling and re-handling of materials—eliminates piling and re-piling—reduces non-productive labor to a minimum.

BARRETT LIFT-TRUCKS

By adopting the Barrett System of handling materials in *your* plant you can save time, money and labor. Ask us to tell you how. Big descriptive book free upon request.

BARRETT-CRAVENS COMPANY
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THE OIL AND WASTE SAVING MACHINE CO.
PHILADELPHIA, PA.

Chip Separators · Oil Filters Oil Reclaiming Machines
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Original Belgian Machinery Wiping Towels

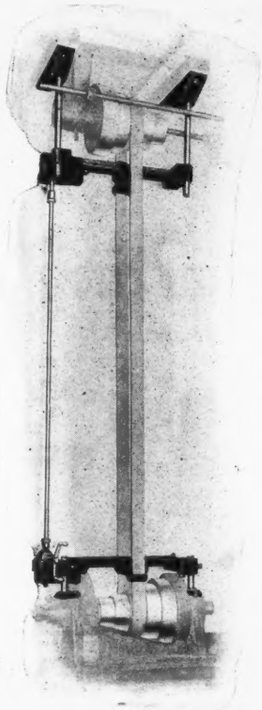
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Our engineers are ever ready to help on drive problems. Our experience is yours for the asking. *Save by securing data and estimates of "Morse Drives."*

MORSE CHAIN COMPANY, ITHACA, N. Y.
Engineering Service, Assistance, Bulletin
Boston, Chicago, Cleveland, Detroit, Greensboro, N. C., New York, Pittsburgh, San Francisco, Atlanta, Montreal, Minneapolis, St. Louis, Baltimore, Philadelphia.

Avoid Accident and Loss of Time
Install the

Safshift Belt Controller

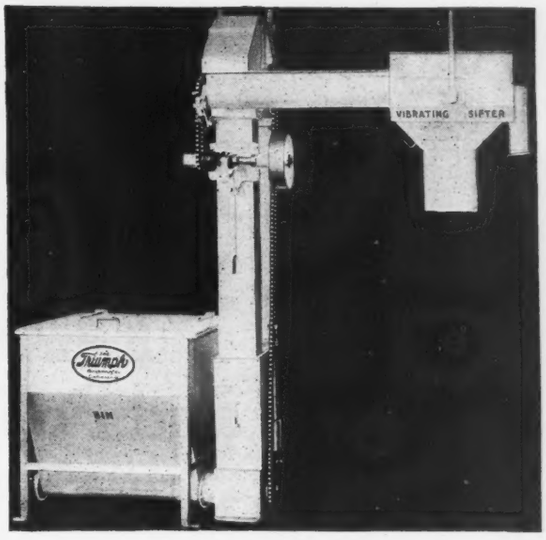


for shifting the heavy belts on those large cone-driven machines. Our No. 4 SAF-SHIFT will shift a 6-inch belt up or down on both cones by simply turning a crank.

Easy to operate. Easy to apply. Made to last.

Let us send you diagrams.

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839 West Sixth St.
CINCINNATI OHIO
(Formerly Lockland, Ohio)



The Durable Drive for Bakery Machinery

This combination all-steel bin, elevator and vibrating sifter—made by the Triumph Mfg. Co. of Cincinnati—is used extensively in modern bakeries.

It depends on two Diamond Roller Chain Drives for the efficient operation of its elevating and sifting mechanism.

DIAMOND CHAIN ◇ DRIVE

best meets the special requirements of this machine, just as it is serving thousands of other power machines, ranging from movie machines to giant drill presses.

It delivers power with high efficiency—possesses great strength and flexibility to absorb sudden shocks and prevent breakdown of drive—reduces friction and wear by its smooth, rolling action—gives long service at low upkeep cost.

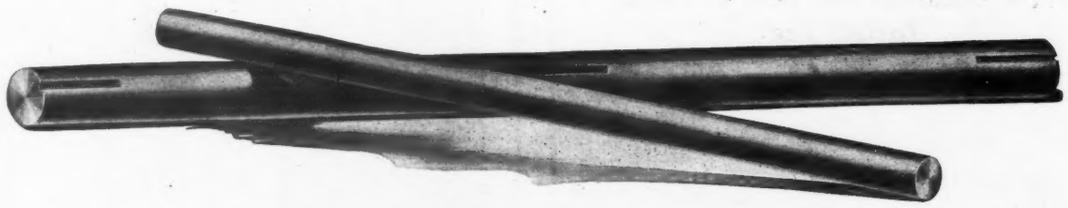
Builders and users of power machines are invited to send us their transmission problems. Thirty years' experience specializing on chain drives enables us to give you unrivalled engineering service.

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Makers of High Grade Chains Since 1890
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CRESCENT BELT FASTENER CO.
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Medart is the only exclusive manufacturer of line shafting equipment producing—*in its own mills*—all of the shafting which it sells.

Medart shafting is made of special steel particularly adapted to the purpose, is perfectly straight, true to size and highly polished—in short, it conforms in every way to those same high standards of mechanical excellence which identify each product comprising the complete Medart line.

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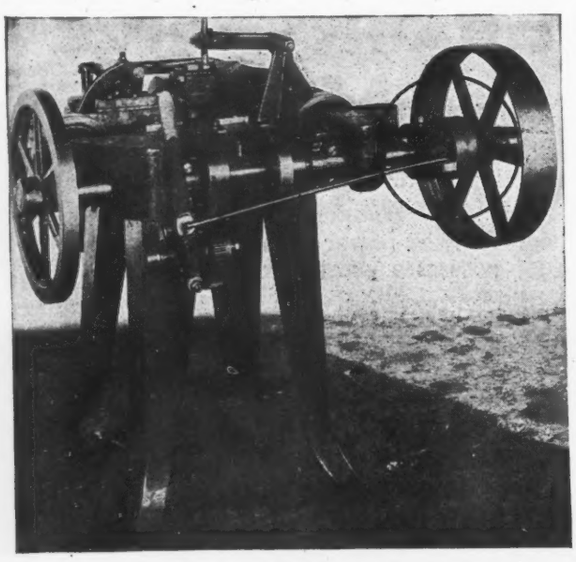
Send for booklet, "Medart Steel Shafting"; submit specifications for large tonnages.

Medart Patent Pulley Company
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MEDART *means* EVERYTHING *in* LINE SHAFTING EQUIPMENT

Controlled by "MULE-PULLS"





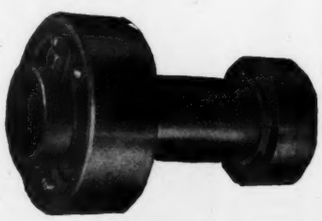
Nilson Automatic Four-slide Machine

Type E. R. (Expanding Ring) MULE-PULL clutches are incorporated in the Automatic Four-slide Machine made by the A. H. Nilson Machine Co. of Bridgeport, Conn.

A Mule-Pull Clutch on a machine tool means absolute control of power and a substantial reduction in the cost of transmitting it.

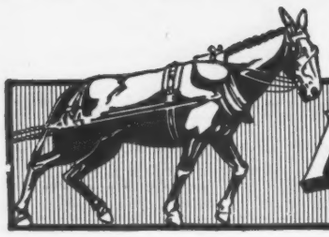
Mule-Pull design is different—many of its features are exclusive.

Complete information is ready for machine tool manufacturers



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Protection Against Neglect

"Nigrum" (impregnated hardwood) Oil-less Bushings serve a definite purpose for which no other type of bushing is so advantageously suited.

At certain bearing points, difficult of access, "Nigrum" Bushings alone will function smoothly and steadily in the face of continued neglect.

We also manufacture "Bound Brook" graphite and bronze Oil-less Bushings.

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Bound Brook Oil-less Bearing Co.

Specialists in the manufacture of Oil-less Bushings for more than a third of a century

BOUND BROOK NEW JERSEY

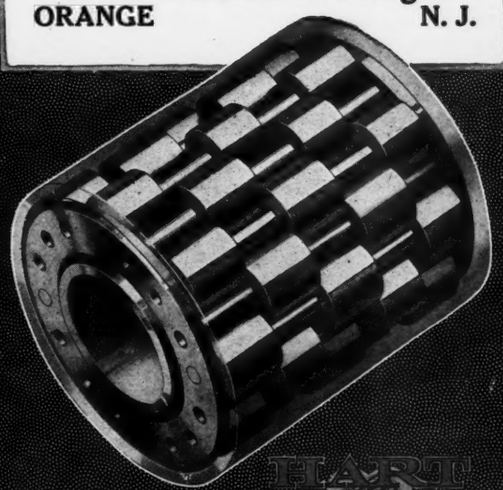
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FOR greater bearing efficiency and low upkeep cost, specify and use HART Roller Bearings.

Staggered rollers of unequal lengths make the HART the heaviest load carrying, best lubricated and longest wearing bearing ever designed.

The Hart Roller Bearing Co.
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RTB CO

NO MATTER what the *direction* or *character* of a machine-tool bearing load, it can be carried satisfactorily and efficiently on Timken Tapered Roller Bearings. A single Timken Bearing does the work of two ordinary bearings—carrying both radial load and thrust load.

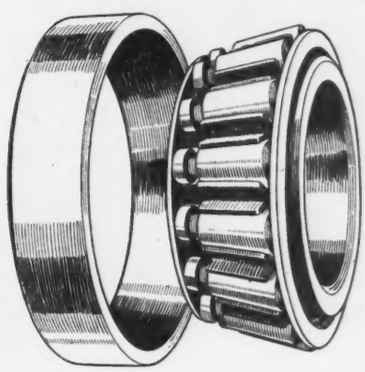
Let a Timken Engineer assist you in the selection of proper bearings for the machine tools you build.

THE TIMKEN ROLLER BEARING CO.
CANTON, OHIO

Plants Manufacturing complete bearings at Canton, O. Columbus, O.; Birmingham, Eng.; Paris, France. General Offices: Steel, Rolling and Tube Mills, Canton, Ohio

Timken Tapered Roller Bearings for Machinery, Industrial Appliances, Passenger Cars, Trucks, Tractors, and Farm Implements.

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RUGGED STRENGTH, "built in," is the reason for FORD TRIBLOC permanence.

It is made by men who, first of all, know by actual experience just what a Chain Hoist must do, and who, secondly, have ever striven to keep the the Ford Tribloc the best Chain Hoist made.

The Hand Chain can't jump the hand wheel flange, for a (patented) loop hand chain guide prevents this. Steel cut gears in planetary drive, set in a dust-proof housing, drop forged steel hooks and high-test steel chain, spell safety. Triblocs are built in capacities ranging from half a ton to twenty—and more.

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Portable Floor Cranes and Hoists

will handle loads up to 6000 lbs. with the assistance of one man. It is an indispensable part of the equipment of leading plants of the country, and is admittedly "The Handiest Tool in the Shop." Note how the Canton places its load—just in the right position. Speedy handling means greater production. Let the Canton do the heavy work. Send for Catalogue E and complete details.

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Represents a proven factor of dependability in chain equipment.

For years the name of MORTON has stood for quality chain of exceptional endurance powers.

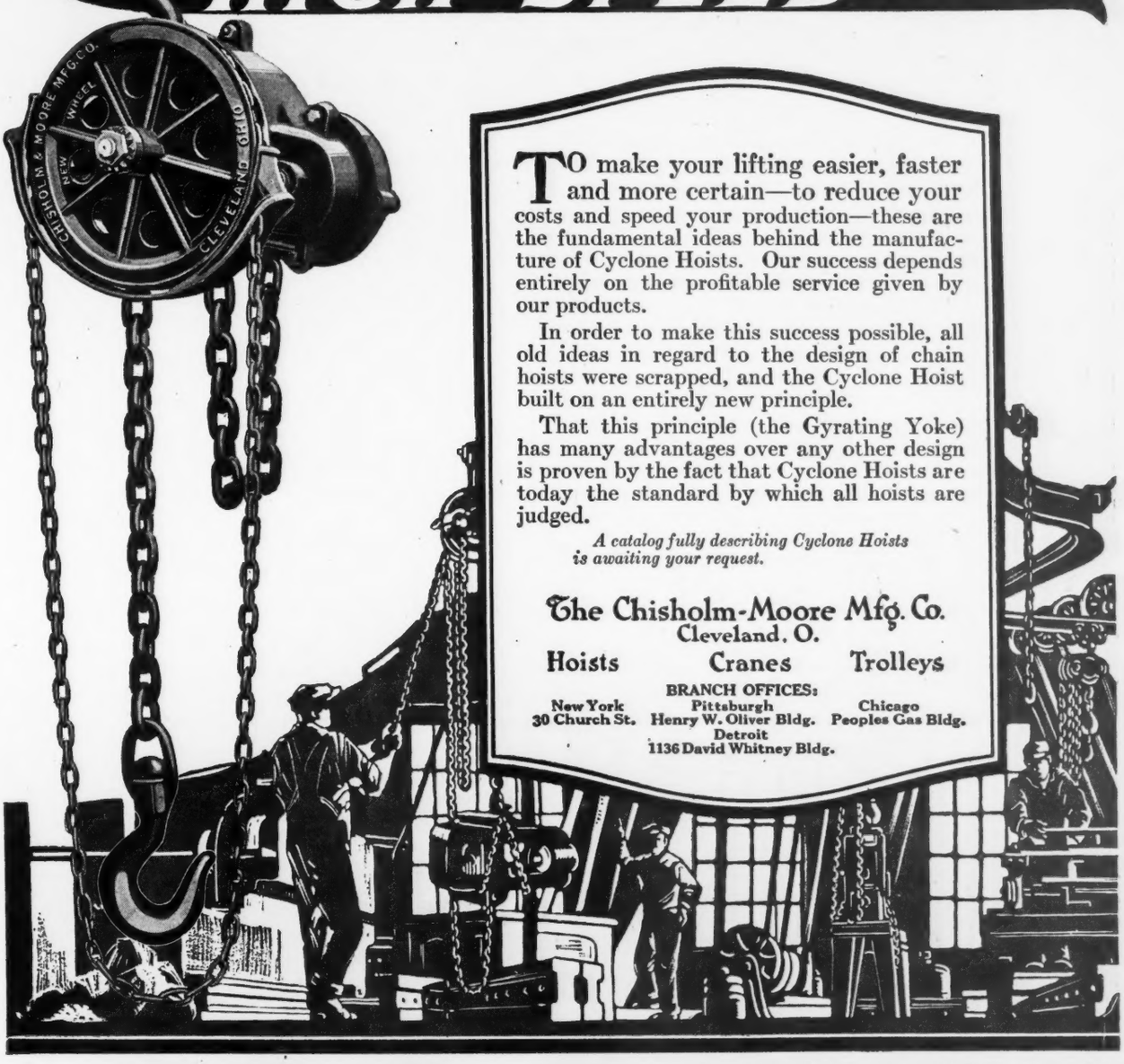
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CYCLONE HIGH SPEED HOISTS



TO make your lifting easier, faster and more certain—to reduce your costs and speed your production—these are the fundamental ideas behind the manufacture of Cyclone Hoists. Our success depends entirely on the profitable service given by our products.

In order to make this success possible, all old ideas in regard to the design of chain hoists were scrapped, and the Cyclone Hoist built on an entirely new principle.

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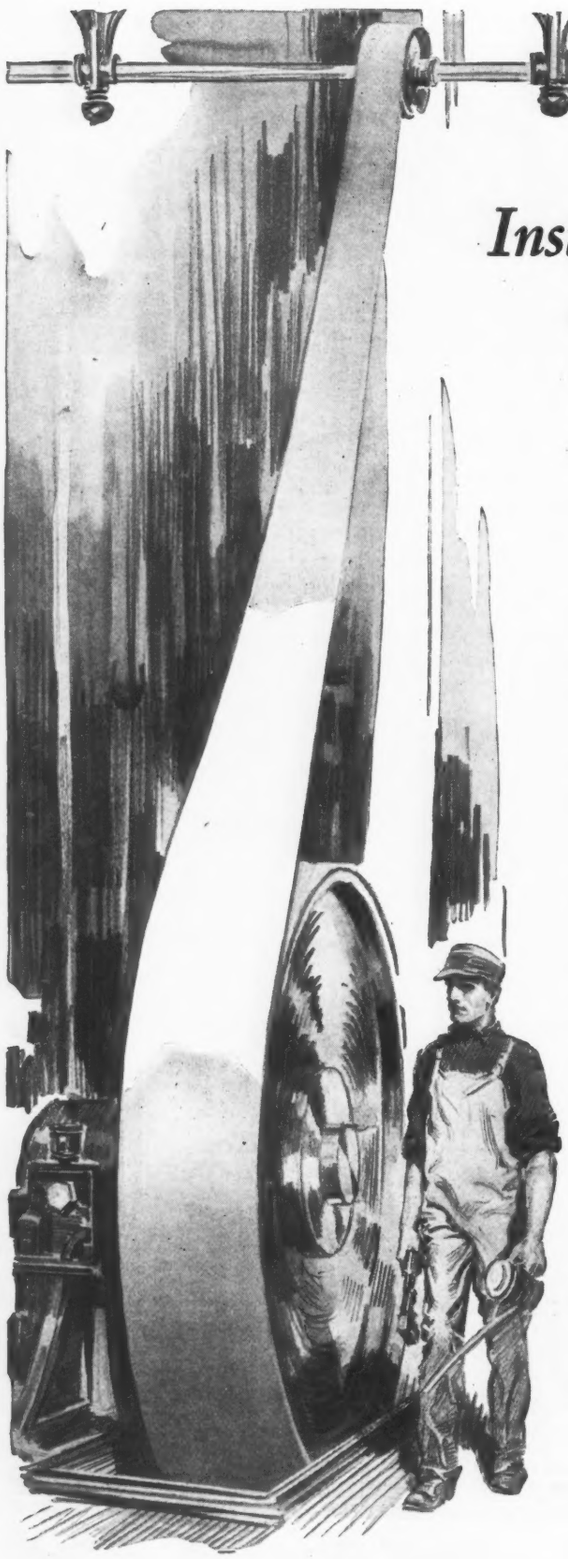
A catalog fully describing Cyclone Hoists is awaiting your request.

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Hoists Cranes Trolleys

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With the traditions that are back of it, there is probably not a piece of plant equipment you can install with more confidence than the "American" Pulley.

For name and address of nearest Dealer, see Donnelley's Red Book. On file at all leading libraries, national banks and hotels.

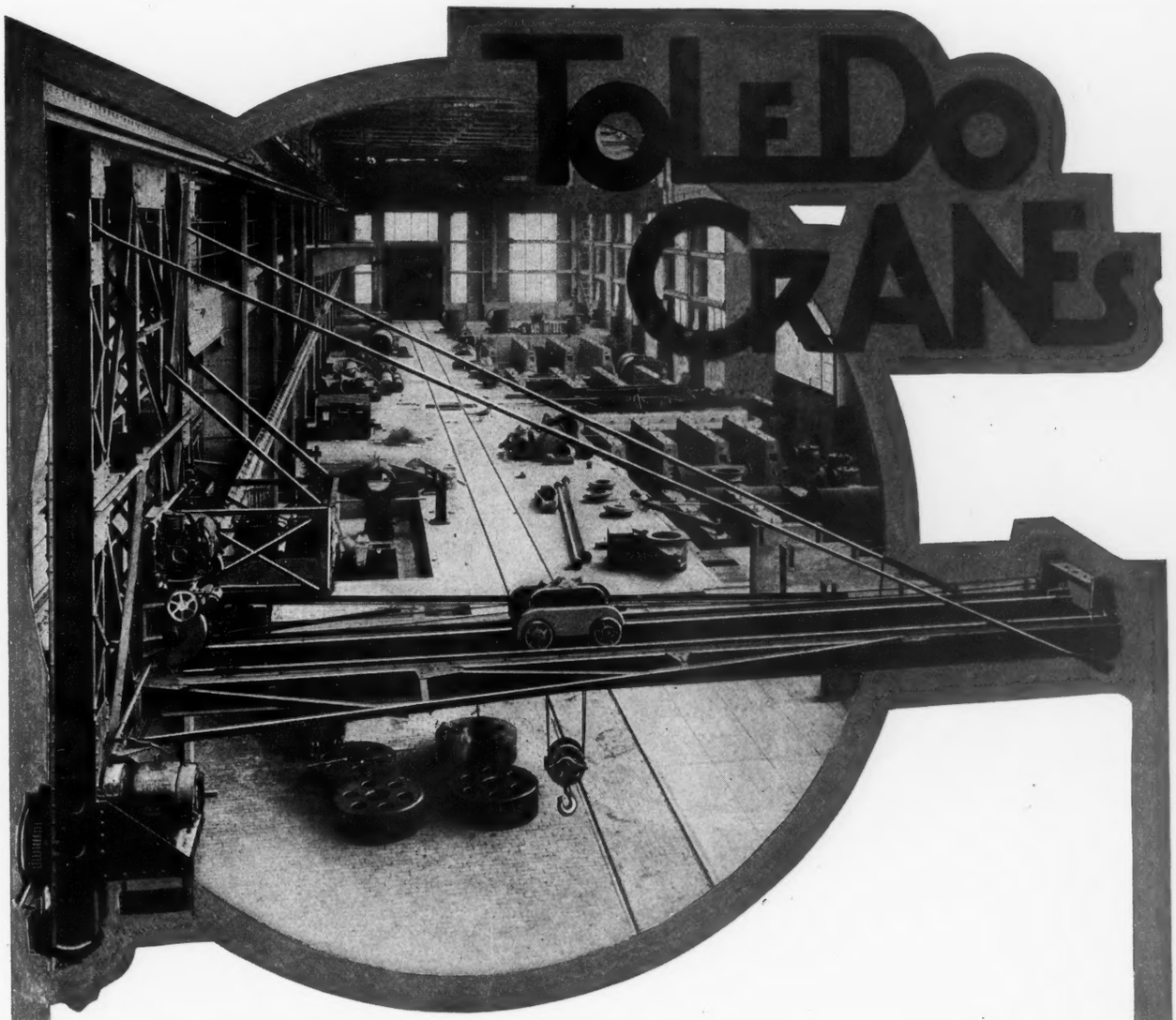
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Philadelphia, Pa.

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"Getting Maximum Pulley Efficiency"

The AMERICAN PULLEY

"A wheel with a broad rim transmitting power from or imparting power to machinery, or changing the direction of motion by means of a flat belt."



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Local transportation is an important item in production costs. The kind of transportation is just as important. Trucking by manual power is both cumbersome and expensive, nor does either give the speed necessary to economy. A small increase in the power bill is better than a big expansion in the payroll. An investment in Toledo Crane equipment now is equal to a perpetual rebate on your wage bill in the years to come, and will save you much trouble, time and annoyance. Investigate.

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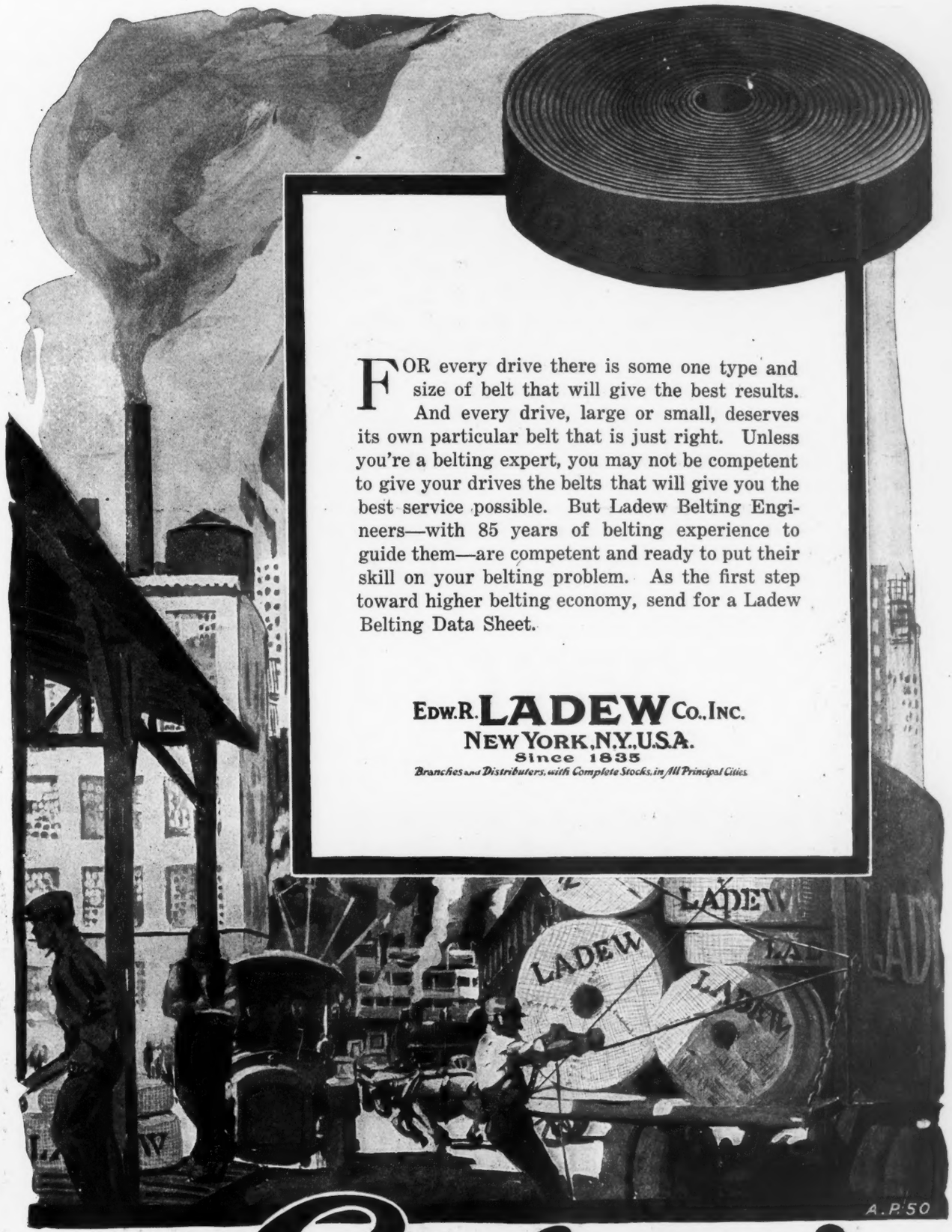


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"Pioneer" Steel Hangers are all of this—the modern standard—regularly used in equipping new factories and installed in older shops as fast as practicable. *Let us tell you about them.*

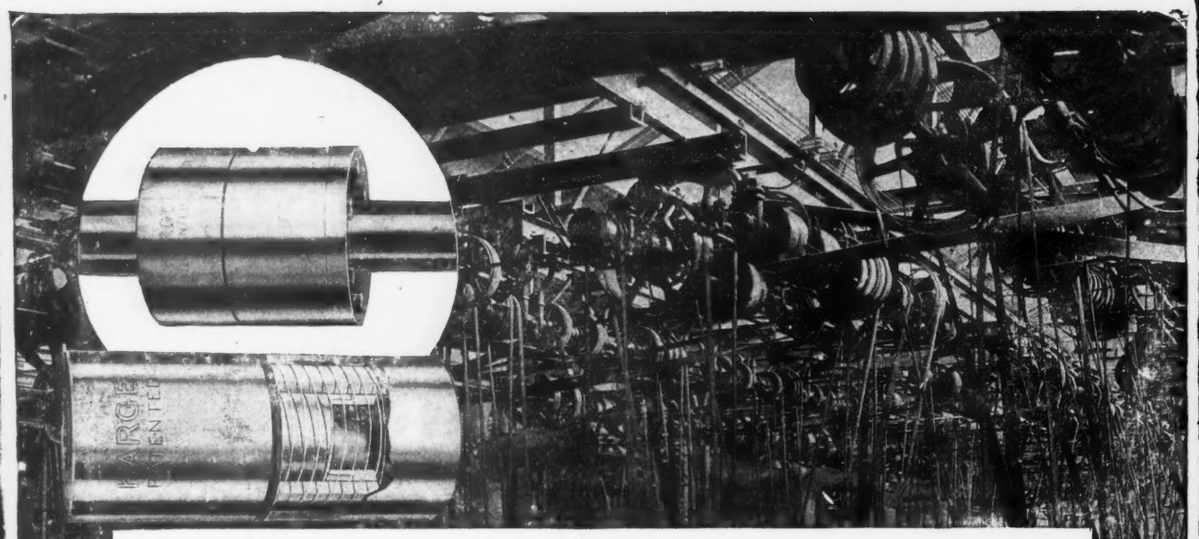
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FOR every drive there is some one type and size of belt that will give the best results. And every drive, large or small, deserves its own particular belt that is just right. Unless you're a belting expert, you may not be competent to give your drives the belts that will give you the best service possible. But Ladew Belting Engineers—with 85 years of belting experience to guide them—are competent and ready to put their skill on your belting problem. As the first step toward higher belting economy, send for a Ladew Belting Data Sheet.

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Kargē Flexible Coupling

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The past two decades have witnessed many wonderful changes in the field of mechanics but the fitting of bearings has gone along in the same old way, blueing, scraping and running in.

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But science was at work on the bearing fitting problem and one day a new marvel was born. Like all marvels it was absurdly simple in operation; marvelous only in the results obtained.

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But all the attainments of this marvelous bearing abrasive are important; so important that the plant that has not yet adopted it is working under a tremendous handicap.

A single test reveals the great benefits of the TIMESAVER method of fitting bearing surfaces. Mail the attached coupon with $1.50 and an ounce can, enough for 300 square inches of bearing surface, will be sent you. Your money will be refunded if you are not entirely satisfied.

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Enclosed $1.50 for ounce can of Timesaver Compound with directions. Money back if not satisfactory.

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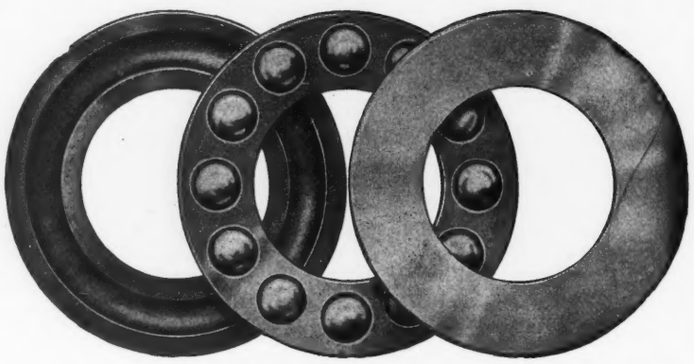
ACCURACY

Accuracy is a word which is inseparable from modern mechanics. Without accuracy fast transportation by road, rail, sea and air would be impossible. Lacking precision the fast moving machinery of the world would be slowed and underproduction would be the consequence.

The uniform close accuracy of Ball & Roller Bearings has been one of the principal reasons for their long and continued success. Combined with selected metals, scientific heat treatment, and correct design, accuracy has made Ball and Roller Bearings the legitimate choice for rapidly revolving parts.

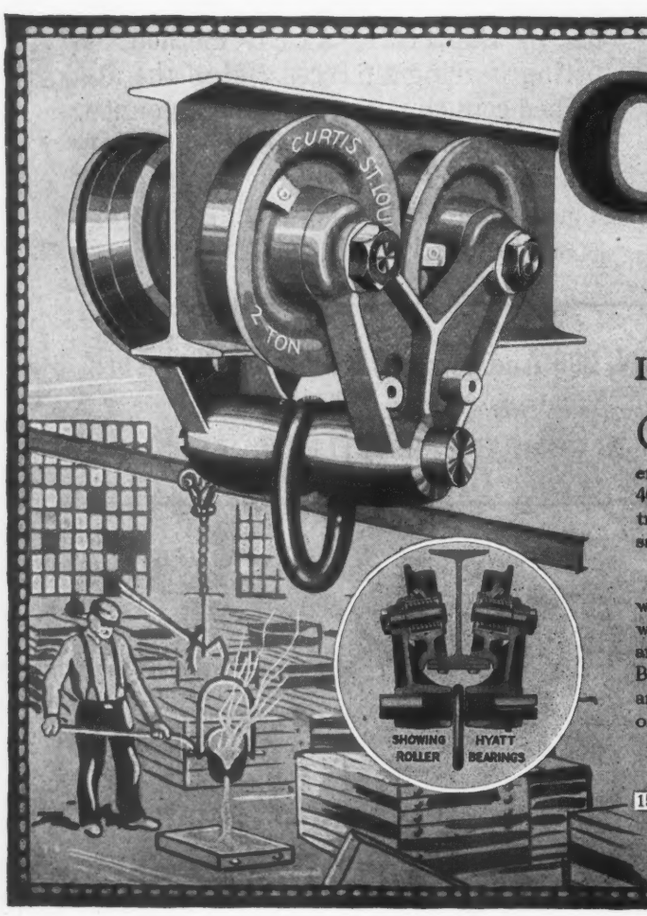
We manufacture Radial Roller Bearings, Journal Roller Bearings, Roller Thrust Bearings, Ball End Thrust Bearings (in both inch and millimeter size) and Cylindrical Rollers. Ask for Catalog 9—It tells the story.





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CURTIS Single I-Beam Trolleys are being used by progressive firms demanding the highest operative efficiency. A Curtis Hyatt Roller-Bearing Trolley with a 4000-lb. load can be moved by a 50-lb. pull, while ordinary trolleys require nearly twice as much power to move the same weight.

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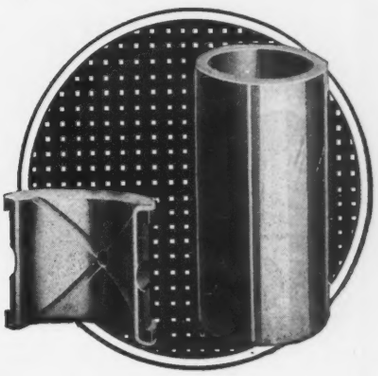
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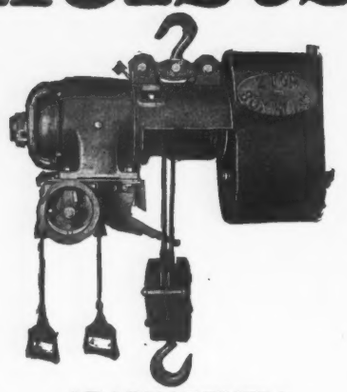
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Electric Hoists



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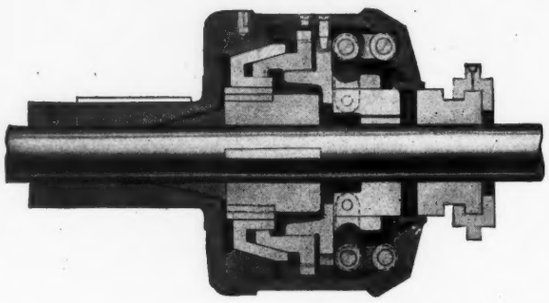
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FOR HIGH SPEED — FOR HEAVY DUTY

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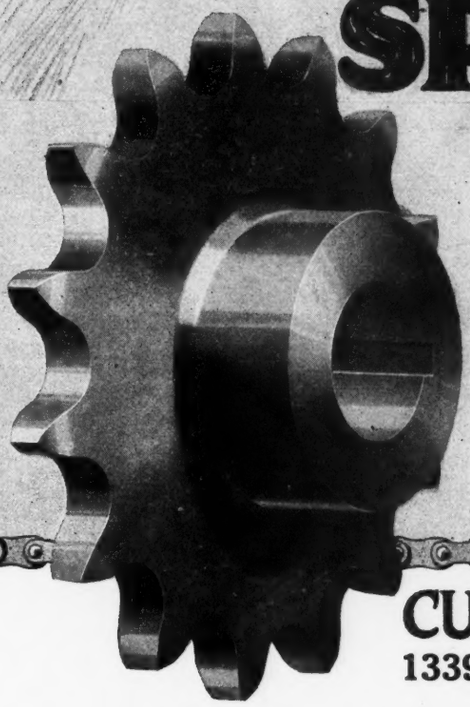
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ROPE DRIVES A SPECIALTY

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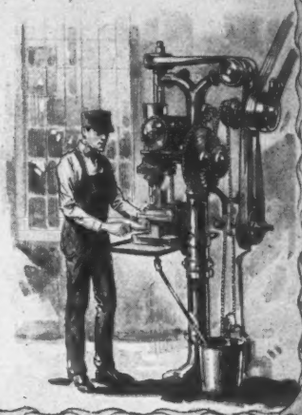
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THIS inexpensive anti-friction bearing has made it possible to make at a marketable price many a machine and device requiring a true anti-friction bearing at low cost.

Send for informative catalog, samples and prices

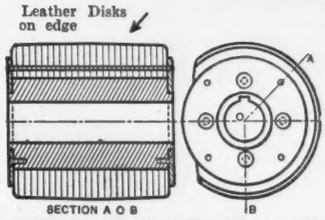


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GREAT BRITAIN: 37 Sheen Road, Richmond, London, S. W.

Belt-Grip Leather Pulleys

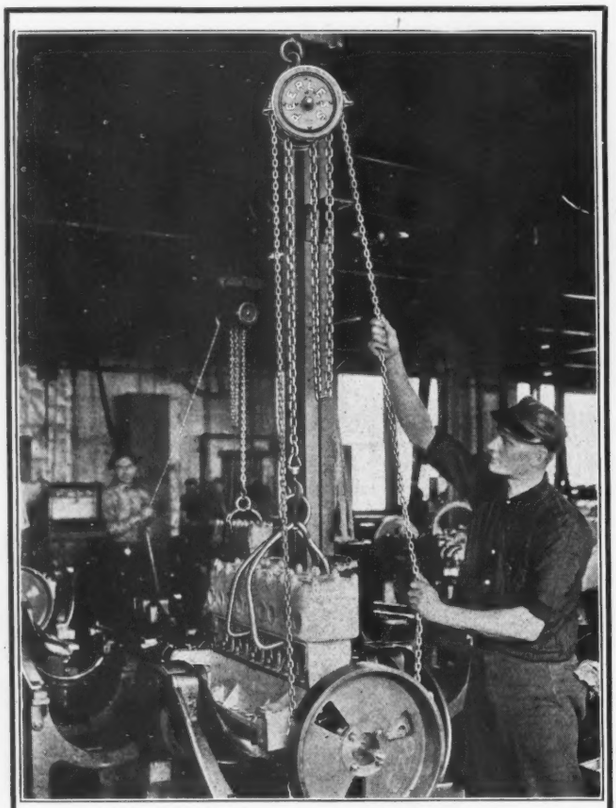
"The Pulley that solidly grips the Belt"





Recommended for use on motors and in all places where there is belt slippage trouble in the transmission of power. Prompt service on special orders. Send for catalogue and full particulars.

BELT-GRIP PULLEY CO.
Buffalo, N. Y.



Lifting the "PEERLESS" Way

We would like to tell you how you can increase your production and lower costs by using Peerless Hoists

Edwin Harrington, Son & Co., Inc., Philadelphia

SAVE POWER

WITH

PULMORE
PULLEY TREAD

FOR HIGHEST BELT EFFICIENCY

Cover your pulley faces with this chemically treated fibre—easily applied to any pulley material—and you'll secure a better surface that grips the belt and conveys full power with looser belts. This means less friction in the bearings and less power waste; and your belts will last longer, too. Write for Bulletin 201.

SMITH AND SERRELL

46 Central Ave. Newark, N. J.

Francke Flexible Couplings for Direct Connected Machinery

Pintite Rigid Couplings for Line Shafting

STEEL BEARING BALLS

ACCURACY AND DURABILITY



QUALITY IS UNEXCELLED

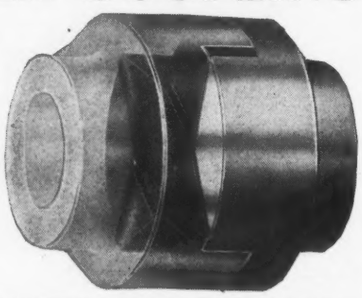
LET US KNOW YOUR REQUIREMENTS

THE ABBOTT BALL CO.

ELMWOOD HARTFORD, CONN.

UNIFLEX COUPLING

Simple, safe, strong and durable. Thoroughly reliable in operation, and covered by a positive guarantee. Incorporate it as an integral part of your machines without fear of a breakdown. Write.



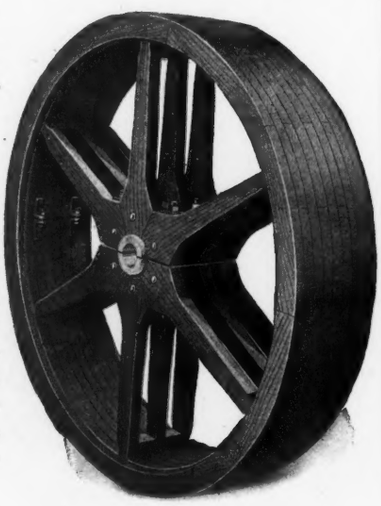
UNIFLEX COUPLING CO.

LAFAYETTE BUILDING PHILADELPHIA, PA.

A Better Drive for the Power Used

Gilbert WOOD SPLIT Pulleys

Highly polished hard wood driving surfaces increase belt adhesion, reducing the power loss due to slippage. Lighter in weight than iron pulleys, Gilbert wood split Pulleys are better able to stand the strain of heavy drives and require less shafting to support them. Used wherever a leather belt can be used.



Circular?

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Sales Agencies in All the Principal Cities in the World. New York Branch, 88 Warren St. Chicago Branch, 105-109 So. Jefferson St. Cable Address, Engrave, A. B. C. and Lieber's Codes.



Schatz
UNIVERSAL
Annular
BALL BEARINGS
Maximum radial capacity, plus 300% greater thrust capacity.
THE FEDERAL BEARINGS CO., INC.
Poughkeepsie, N. Y.

Protect Your Bearings with



The Patented "Conus" spring cover, a feature found only in "Conus" Oil Cups.

CONUS

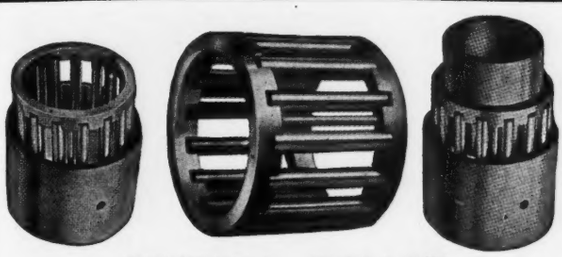
OIL CUPS

Made of high grade Swedish steel heavily nickeled. Installed without tapping.

Ask for catalog and sample

Simple—Efficient—Economical

AMERICAN GALCO CO., Inc.
Grand Central Palace *Sole Distributors* New York City



JOURNAL ROLLER
BEARINGS
One Bearing — or one thousand
THE GWILLIAM COMPANY
253 West 58th St. NEW YORK



"NORMA"
PRECISION
BALL BEARINGS
(PATENTED)

There is but one true measure of value—the capacity for service. It is a recognition of this fact by responsible manufacturers of high speed machines which has made "NORMA" Precision Bearings the accepted standards in the equipment they build—machines subject to hard, day-after-day, driving service under severe conditions which exact the utmost from the bearings. And "NORMA" serviceability is helping these machines maintain their nation-wide reputation for reliability.

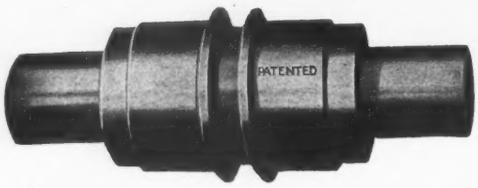
See that your machines are "NORMA" equipped

THE NORMA COMPANY OF AMERICA
Anable Avenue
Long Island City
New York



Ball, Roller, Thrust and Combination Bearings

THE HANSON MACHINE CLUTCH



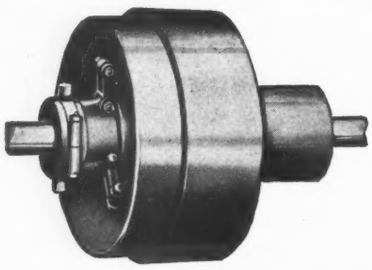
Entirely cylindrical, perfectly balanced, compact, simple, powerful, reliable, fully interchangeable. Use with confidence.

Our engineering department is at your service. Send a sketch or blueprint of the part of the machine into which you wish to work the Hanson Clutch and we will prepare drawings, submit figures, etc.

Catalog

THE HANSON CLUTCH & MACHINERY CO.
TIFFIN, OHIO, U. S. A.

How Safe is Your Plant?



WHAT ABOUT CLUTCHES?

Moore & White Friction Clutches offer the widest margin of safety possible. In case of accident or emergency, machines so equipped can be stopped on the instant. M & W Clutches have no projecting parts, cannot engage accidentally, always run true, are simple, fool proof, do not throw oil. A reliable clutch for every purpose.

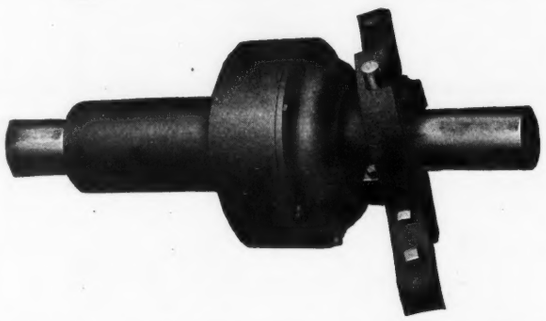
An interesting new catalog is waiting for your address. When shall we send it? Ask for Catalog M.

Made only by

THE MOORE & WHITE CO.
34 Years' Experience at Your Service. Established 1886
2707-2737 North 15th Street Philadelphia, Pa.

Sold by leading dealers in Mine, Mill and Factory Supplies

Cleveland Clutches



ENCLOSED—SAFE—EFFICIENT

Made as single or double clutch or cut-off coupling. Readily fitted to special machines.

Specify "Cleveland." Write for information

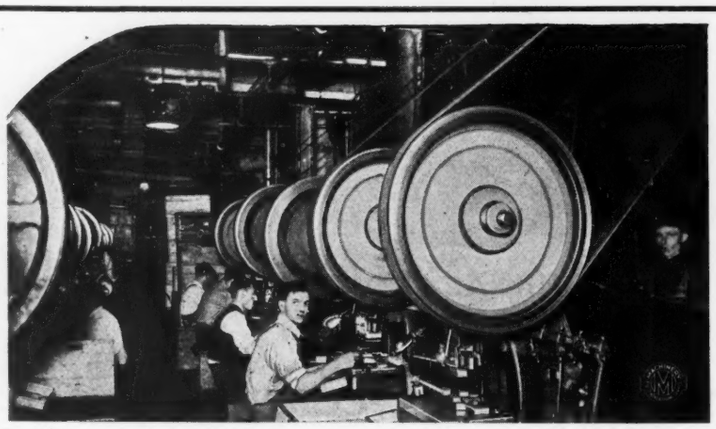
Reliance Gauge Column Co.
6008 Carnegie Ave. Cleveland, Ohio

HILLIARD
FRICTION CLUTCHES

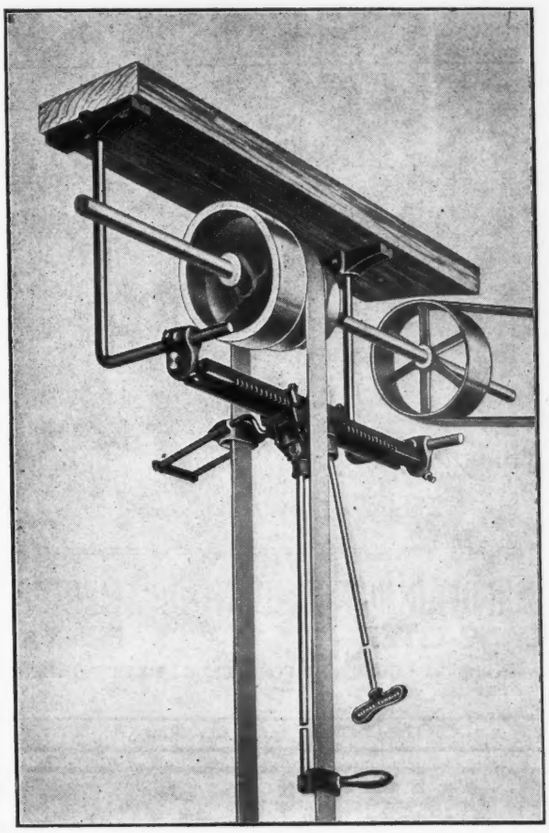
An integral part of the driving mechanism of many high grade machines. They give direct individual control with increased accuracy and reduced power waste, eliminate countershafting and reduce the amount of belting used. No toggle joints or complicated mechanism to get out of order.

Ask about our free trial offer.

The Hilliard Clutch and Machinery Co.
ELMIRA, N. Y. U. S. A.



THE KREMER-CUMMINS Mechanical Belt Shifter



A Safety-First Device

That Meets All Requirements

$15.00

secures this practical solution of the belt-shifting problem. It is durably constructed, readily attached and simple to operate. Exclusive advantages recommend it, many leading manufacturers endorse it and a trial installation quickly demonstrates its worth.

Details in Circular "M"

KREMER-CUMMINS MCH. CO.

East 55th St. & Hough Ave.

CLEVELAND, O.

FRANCKE

FLEXIBLE COUPLINGS

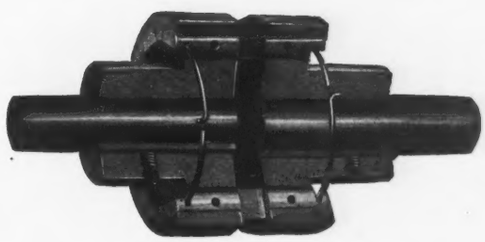
For Direct Shaft Drives

All the lubrication you can give them won't protect your direct-connected machines from the binding, grinding friction that comes with shaft misalignment.

Give your machines **Francke** protection, and you'll be free from this costly wear and tear—for each shaft will be free to run smooth and free in its own two bearings.

And you'll have the cushioning effects of laminated steel springs in the **Francke,** to protect your motors from shocks and jars of heavy load changes.

Write for bulletin 126.

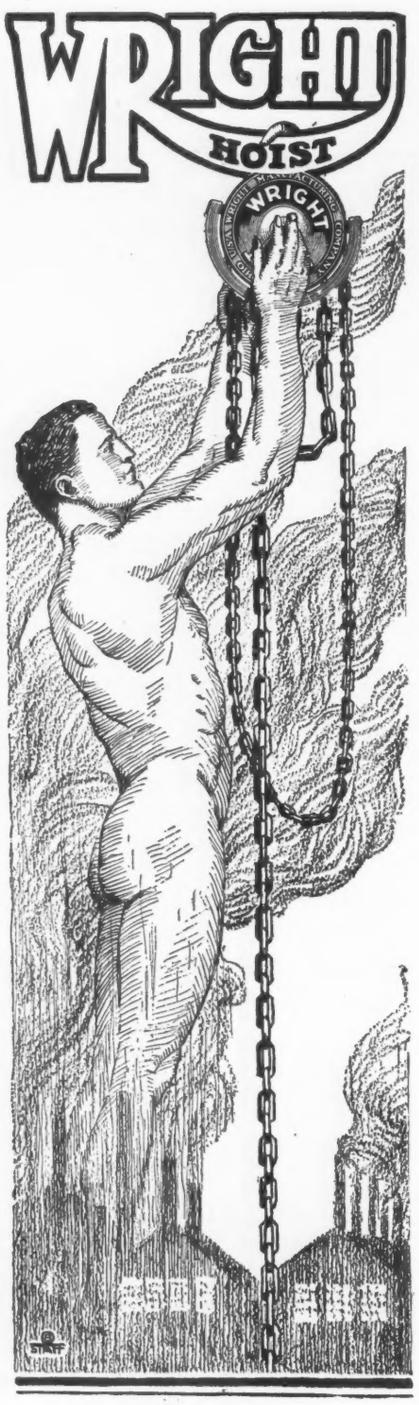


SMITH AND SERRELL

46 Central Ave. **NEWARK, N. J.**

Pintite Rigid Couplings for Line Shafting

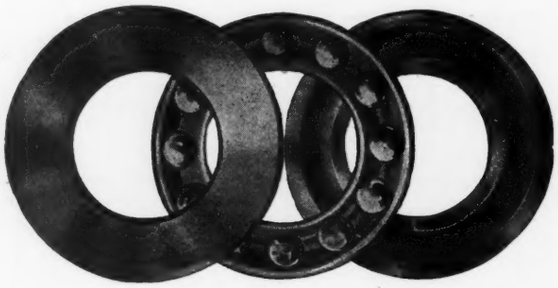
Pullman Pulley Transmission for Highest Belt Efficiency



Let the hoist that's upheld by its own perfection do your lifting.

WRIGHT
MANUFACTURING COMPANY

LISBON OHIO
U. S. A.



We offer our services to the engineering fraternity on layouts requiring Ball Thrust Bearings. Our broad engineering experience in Ball Bearings is at your disposal.

Ball Thrust Bearings manufactured to your requirements.

"Star" Ball Retainers for Thrust, Magneto and Cup and Cone Bearings.

DROP FORGINGS

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LANCASTER PENNA.
Western Sales Office: 1012 FORD BLDG., DETROIT, MICH.



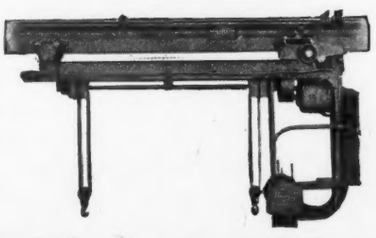
CRESSON-MORRIS CO.

Power Transmitting Machinery

We make a specialty of equipping plants completely with power transmission machinery: including shafting, rope-transmission, machine-cut and molded iron and steel gears for heavy service.
Almost sixty years' experience and competent engineering advice are at your disposal.

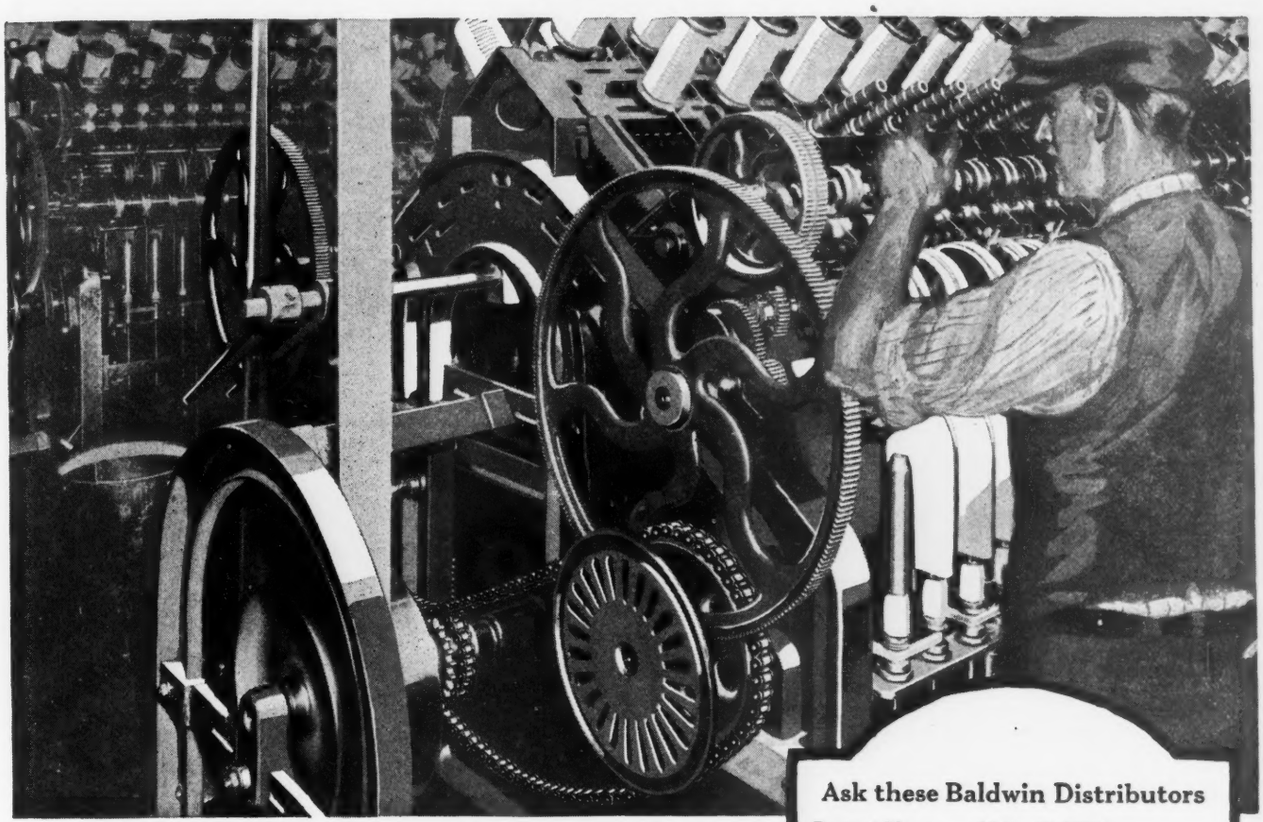
CRESSON-MORRIS COMPANY
Engineers—Founders—Machinists
PHILADELPHIA PENNA., U. S. A.
Branch Office: 141 Milk Street, Boston, Mass.

Get our Catalogs and see how to save your handling expenses.



NORTHERN CRANES AND ELECTRIC **HOISTS**

NORTHERN ENGINEERING WORKS. DETROIT. MICH.



Baldwin Chain Drive in use in Textile Mill

ONE of the outstanding features of a Baldwin chain drive is positive action. Chain drives cannot slip or stretch. Their application as a drive on machines assures a permanent, trouble-free method of transmitting power that possesses, in addition to its positive action, the necessary flexibility to absorb shocks and strains and protect more delicate mechanisms.

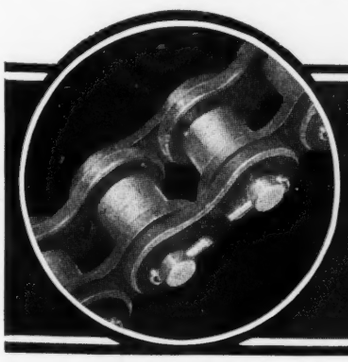
Ask the Baldwin representative nearest you for any information or assistance you may require in designing industrial drives for the machines you build.

BALDWIN CHAIN & MANUFACTURING COMPANY
WORCHESTER, MASS.

MR. H. V. GREENWOOD, *General Western Sales Agent*
PEOPLES GAS BUILDING, CHICAGO, ILL.

Ask these Baldwin Distributors

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Los Angeles, Cal.	Colyear Motor Sales Co., 1222-1226 South Hill St.
Minneapolis, Minn.	Baldwin Service Co., 39 South 11th St.
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Seattle, Wash.	Wade & Co., 313 E. Pine St.
St. Paul, Minn.	C. J. Smith & Co.,
St. Louis, Mo.	American Automobile and Supply Co. 3200 Locust St.
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GENUINE BALDWIN CHAINS

THE SHAW ELECTRIC CRANE COMPANY

WORKS MUSKEGON, MICHIGAN

SALES OFFICES IN ALL PRINCIPAL CITIES

MANNING, MAXWELL AND MOORE, INC.

PRINCIPAL OFFICE - 119 WEST 40TH. ST., NEW YORK.

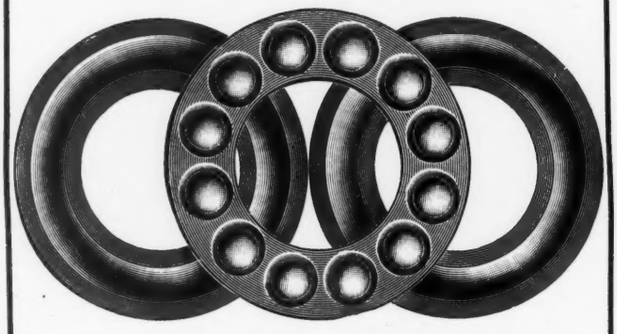
ARMINGTON
Hand and Electric
HOISTS AND CRANES



Our Standard Single Girder Crane

Traveling and Jib Cranes—Special Cranes
Hoists and I-Beam Trolleys

THE ARMINGTON ENGINEERING CO.
EUCLID OHIO



USED ON THE BEST

Drill Presses	Textile Machinery
Lathes	Rubber Machinery
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Motors	Blowers
Cranes	Elevators

THE BANTAM BALL BEARING CO.
BANTAM, CONN.

F. M. COBBLEDICK CO.
693 Mission St.
San Francisco, Cal.

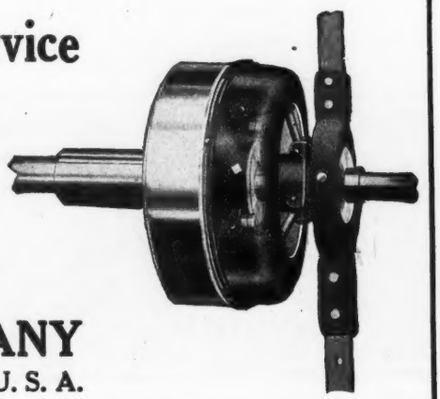
DETROIT OFFICE
905 Dime Bank Bldg.
Detroit, Mich.

"Edgemont"—the EM Co Clutch for Hard Service

Designed for heavy, rough service—to be thrown in and out constantly, to slip and pick up the load slowly or to run at high speed without picking up the load or dragging.

Guaranteed to transmit full rated power, to operate satisfactorily and to be well made in every particular.

This Clutch Has Made Good. Continuous repeat orders and a constantly increasing number of machine tool builders adopting it prove its worth.



Catalog describes Edgemont Clutches for all purposes

THE EDGEMONT MACHINE COMPANY

2700 National Ave. DAYTON, OHIO, U. S. A.



Silent Chain Drive Increased His Piece Rate Earnings 18%

THIS man is employed in one of America's leading manufacturing plants. He performs turret lathe operations on duplicate parts on a piece work basis.

Until recently his machine was belt driven. Now it is driven by Link-Belt Silent Chain. Since the change was made, his piece work earnings have increased 18%.

This increase was made on the same machine, same class of work, same operations, same hours, same everything as when belt drive was used.

His increased output is the direct result of the positive, non-slipping, smooth running effect of Link-Belt Silent Chain on the work in hand.

You, too, can increase the output of your plant, better your product and enable your piece work operators to enjoy greater returns by adopting Link-Belt Silent Chain Drive.

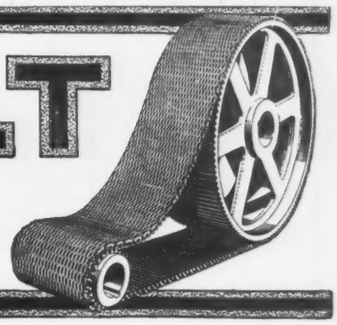
It is "flexible as a belt, positive as a gear, more efficient than either." Send for our Machine Tool Drive Book No. 312. Shows many applications and gives details.

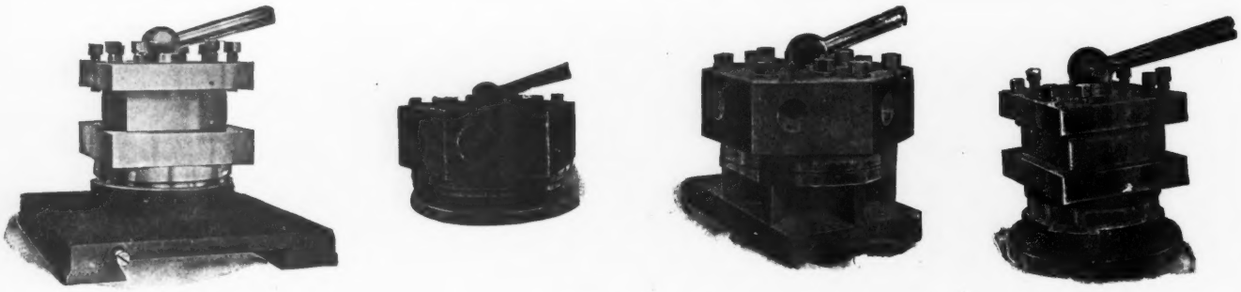
LINK-BELT COMPANY 204

PHILADELPHIA CHICAGO INDIANAPOLIS

New York - - 299 Broadway
Boston - - 49 Federal St.
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St. Louis - Cent. Nat'l Bank Bldg.
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Seattle - 576 First Ave. S.
Portland, Ore. - - First and Stark Sts.
San Francisco - - - 582 Market St.
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Toronto, Can., Canadian Link-Belt Company, Ltd.
Denver, Lindrooth, Shubert & Co., Boston, Bldg.
Louisville, Ky., Frederick Wehle, Starks Bldg.
New Orleans, C. O. Hinz, Hibernia Bank Bldg.
Charlotte, N. C., J. S. Cothran, Com'l Bank Bldg.

LINK-BELT
SILENT CHAIN
FOR POWER TRANSMISSION





Makes Any Engine Lathe 100% More Useful.

PHOENIX Tool Post Turrets and Phoenix Carriage Turrets are recognized in up-to-date shop practice as being so necessary, that they are even being put on brand new engine lathes as regular equipment.

Those "in-between" jobs—those that can't be worked to advantage on the turret lathe, and cost too much on the engine lathe—fall naturally within the Phoenix range of work. The Phoenix Tool Post or Turret will increase the capacity and efficiency of any engine lathe 100 per cent.

A three-quarter turn of handle releases the Phoenix locking device and brings the next tool into play without readjustment and accurately adapts itself. It locks quick—it locks rigid. It won't tip—it won't shear. Write for full particulars.

PHOENIX MANUFACTURING CO.
Eau Claire, Wisconsin
Cleveland Office: 913-15 Engineers Bldg.

PHOENIX TOOL POSTS AND CARRIAGE TURRETS



Guess Work vs. The Scleroscope

In spite of many years' experience in heat-treating steel "by eye," the Keller Mechanical Engraving Company, of Brooklyn, N. Y., had considerable trouble in keeping its dies up to standard because of the lack of uniformity in the steel—each new lot being just a little different from the last.

Whether the die broke in testing because it was too hard, or wore down quickly because it was too soft, the fact remained that costs for "experimenting" ran high until this Scleroscope was installed about five years ago. Nowadays there is no uncertainty as to results—as the superintendent says: "Since we installed the Scleroscope we **know.**"

When writing for the "Scleroscope Book" be sure to ask about the Pyroscope and Selective Carbonizing and Hardening by the Shore Process.

The Shore Instrument & Mfg. Co.
VAN WYCK AVENUE & CARLL STREET, JAMAICA, N. Y.

FOREIGN AGENTS: Agent for Great Britain and Colonies, Coats Mch. Tool Co., Ltd., 14 Palmer St., Westminster, London, S. W.; Glasgow, Newcastle-on-Tyne. Yamatake & Co., Tokyo, Japan. Iznosskoff & Co., Petrograd, Russia. Aux Forges de Vulcain, Paris, France. R. S. Stokvis & Zonen, Ltd., Belgium and Holland.

OAKITE CLEANS



2000 Auto Parts for 78 cents

THIS Auto Factory* now uses Oakite for cleaning mineral oil from fenders, aprons, radiator shells, etc., before japanning, *at a fraction of former cost.*

The parts were formerly washed with a prepared alkali cleaner, and averaged 6 per cent. rejects after japanning.

With Oakite materials, the rejects average only one in 800!

The actual cost of Oakite materials for cleaning each lot of 2000 parts, is 77½ cents.

But in computing the *full economy* in using Oakite materials, due consideration must be given to the saving effected in practically eliminating rejects.

This Advertisement is one of a series based on actual occurrences.

* *Name upon application.*

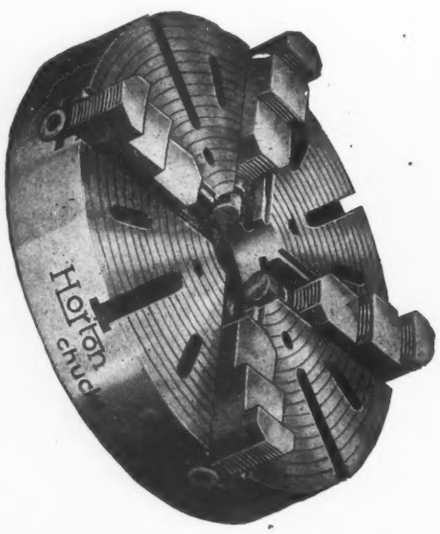
May we serve YOU too?

OAKITE MANUFACTURED BY OAKLEY CHEMICAL CO. 26 THAMES STREET · NEW YORK



All Steel Independent Chucks

(Number 3 of eight Horton Leaders)



The body of this chuck is cast of a steel practically equal to machinery steel. This, together with the very wide jaws, the heavy operating screws, the deep ribs and the generally ample proportions make this a practically unbreakable chuck.

The large center hole enables the hub of the work to be passed back into the center hole of the chuck.

This line of steel chucks is only one of eight Horton leaders. A chuck for every chucking requirement, and every chuck built for present-day usage is a Horton accomplishment.

By special invitation a member of the Rice Leaders of the World Association.

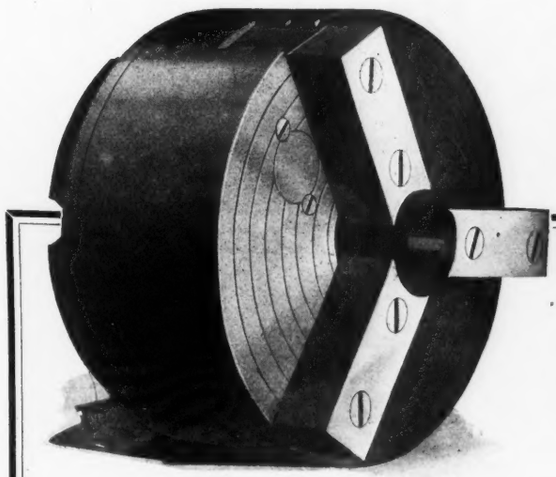
BY INVITATION MEMBER OF
RICE LEADERS OF THE WORLD ASSOCIATION
NEW YORK, U.S.A.

THE E. HORTON & SON CO.

WINDSOR LOCKS CONN., U. S. A.

Horton chucks

109-11



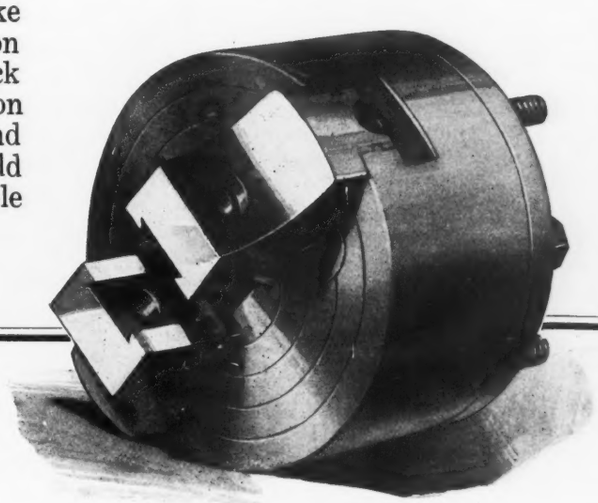
(Patented 2-28-20)

LAVOIE AIR CHUCKS

Quicker Handling
Increased Production
Greater Economy

Lavoie Air-operated Chucks are unique in constuction, and have many important features. No air is required to release the work on completion of operation, nor is any special adaptation of cylinder to the rear end of spindle necessary. Single piping, and the fact that there is only one packing in the chuck eliminate the surplus leakage of air.

The Lavoie three-jaw chuck is adapted to take care of general production work. The two-jaw chuck is designed for production such as brass work, and light production where odd shapes require a simple method of chucking.



(Patented 2-28-20)

Write for Details

The Frontier Chuck & Tool Co., Inc.

30 Letchworth St., Buffalo, N. Y.

Strong Gripping Power

Reason No. 2



The CASLER
Twin Screw Drill Chuck

We've turned this simple, well made device inside out so you can see for yourself the reasons for its strength and durability. Jaws and screws are of high carbon steel, tempered. Screws are the same size and unusually large—an exclusive feature with a two-fold advantage — first, they hold the drill with a uniform and powerful grip which eliminates all possibility of slipping and turning; second, the strain on the two screws is equally divided which adds appreciably to their term of service.

Other reasons—all equally good and sufficient—will be found in our circular. Send for it.

MARVIN & CASLER COMPANY

Canastota New York

McCrosky
COST CUTTING TOOLS

Service Without Limit

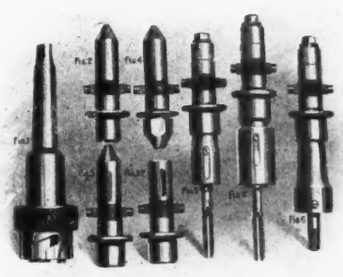
The Jackson Shaper Co. (Jackson, Mich.) makers of the Walcott Shaper, find use for

McCrosky Wizard Chucks and Collets

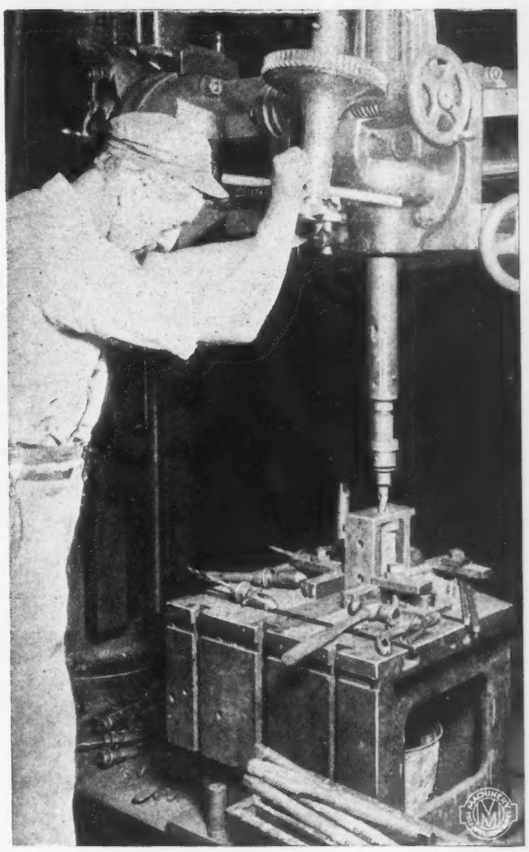
on exactly 110 different operations

The one shown is not very spectacular, but it requires a lot of power. In machining these cross-feed nuts, in which, as part of this operation, is cut a double acme thread of ½" lead, a big Radial Drilling Machine and high-speed tools are used, with a little Wizard Chuck to transmit the drive to the cutting tool and carry the biggest strain that is put on any part of the machine.

An accurate, positive chuck for the most powerful high-speed machines—a chuck which makes non-stop runs possible on several operations work—these things make Wizard Chucks and Collets first choice everywhere when once they have been used.



A Typical Wizard Outfit



Try a Wizard Chuck and Collet Outfit and test our claims. Send for the McCrosky Efficiency Book No. 7 for further details of these and the other McCrosky Efficiency Devices.

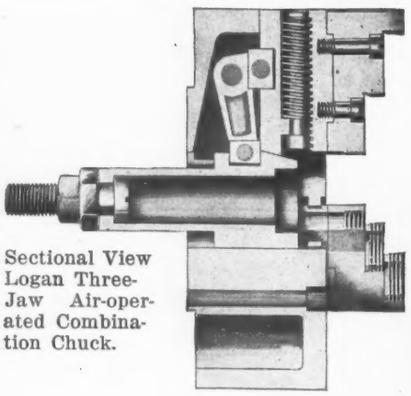
McCROSKY TOOL CORPORATION

MEADVILLE, PENNSYLVANIA

Branches and Agencies in all Principal Cities. Export Agent: Benjamin Whittaker, Inc., New York

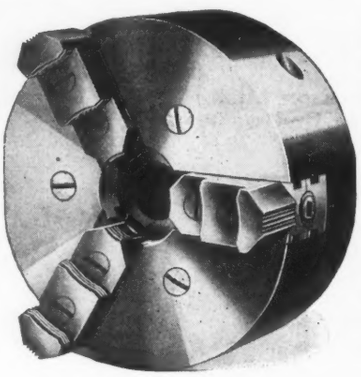
Logan Air-Operated Chucks

MANUFACTURED BY THE LOGANSPORT MACHINE COMPANY, LOGANSPORT, INDIANA



Sectional View Logan Three-Jaw Air-operated Combination Chuck.

Because of their improved jaw-operating mechanism, these practical and efficient chucks insure a positive grip on the work at all times: powerful and rigid, but without undue weight or overhang. They have compact, one-piece bodies without bolts, screws or other frequent causes of chatter and are particularly dust-proof.



Logan Air-operated Three Jaw Combination and Universal Chucks are furnished with steel or semi-steel bodies, 9½", 12", 15", 18" and 24" diameter.

Sectional View Logan Three-Jaw Air-operated Universal Chuck (non-adjustable jaws).



Logan Air-operated Chucking Devices include Two and Three Jaw Chucks, Collet Chucks, Air Cylinders, Fixtures for Automatic and Continuous Milling Machines, etc.

Details in Bulletin MR-10

GENERAL SALES AGENTS

FRANK G. PAYSON COMPANY 9 South Clinton Street, Chicago, Ill.

Woodstock Safety Tapping Chucks

Try one for 30 days at our expense



Not satisfied with successfully tapping blind holes all day without breaking a single tap, this young operator has determined to find out "why."

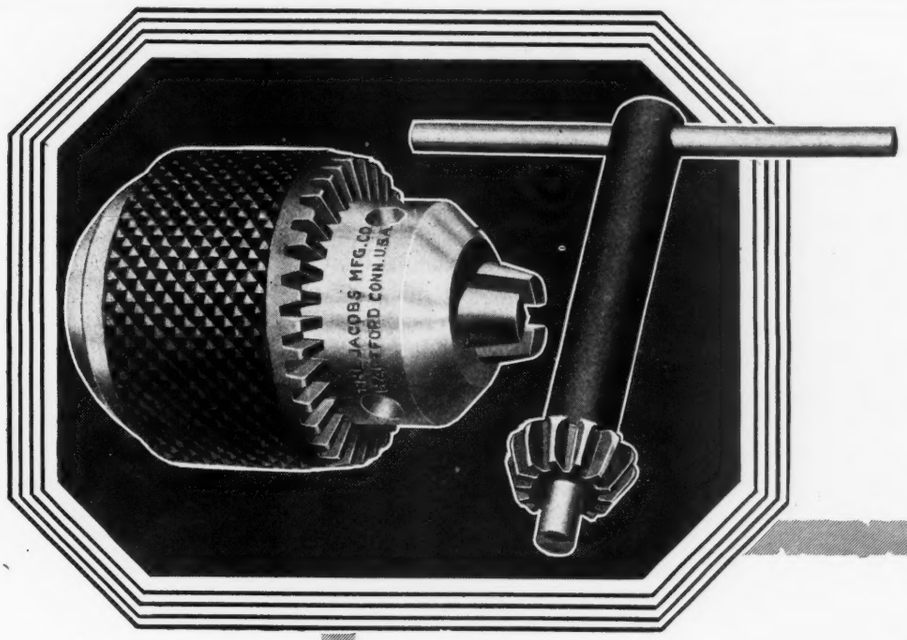
No need, however, for the foreman to worry about the safety of the Woodstock Safety Tapping Chuck in inexperienced hands. The mechanism is simple and fool-proof, consisting of an adjusting nut, a spring and two friction cones—nothing to stick or get out of order in action and only one obvious method of assembling. It's safe from every viewpoint; eliminates tap breakage and utilizes 95 percent of the strength of the taps.

When tap breakage becomes excessive, we recommend investigating Woodstock Safety Tapping Chucks.

PETER BROTHERS MFG. COMPANY

135 Railroad Avenue

ALGONQUIN ILLINOIS



An Accessory? Yes--------but

An accessory will sometimes through sheer intrinsic merit of its own assume the importance of a principal.

The exceptional performance of Jacobs Chucks resulting in greater efficiency, convenience, ease of handling, and economy in drilling operations is a case in point.

When you buy Jacobs Chucks for your plant, or drills equipped with Jacobs Chucks, you are buying better drilling. Henceforth you think of Jacobs Chucks as the principal in connection with better drilling.

THE JACOBS MFG. CO.

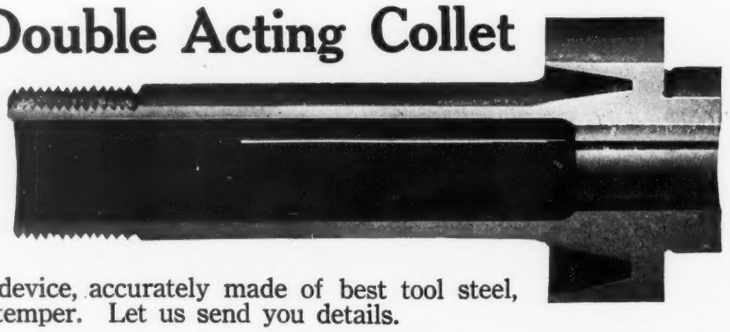
Dept. M.

HARTFORD — CONN.

Jacobs Chucks

The "Inanout" Double Acting Collet

A New Departure Which Saves Chucking Time



A simple and extremely practical device, accurately made of best tool steel, heat treated and drawn to spring temper. Let us send you details.

MORRISON MACHINE PRODUCTS, Inc., Rochester, N.Y.

UNION CHUCKS



Made in seven sizes with holding capacity from ¼ to 2 inches.

The Union Drill Chuck is a positive, accurate, friction drill chuck for general use. It is durably made of the best material and has a Patent Transverse Slot which provides for inserting drills with tenons—a distinctive advantage which *you* will appreciate.

The Union line includes practical chucks for every purpose. Complete description in catalog.

Union Manufacturing Company

New York Office
26 Cortlandt Street

New Britain, Conn., U. S. A.

Makers of a Complete Line of Chucks

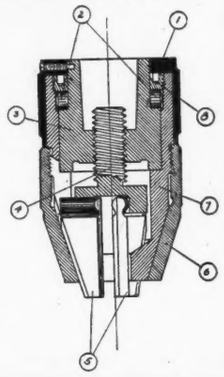
NeBaCo Eclipse Drill Chucks

Hand Operation—Instant Action

Note the Construction

A Sleeve (1) rotates on the outside of the body (7) and is fastened to the Head (3); grasp the Sleeve with one hand and turn the Body with the other, the Jaws grip the Drill positively and release easily. Can be used on Electric Drills.

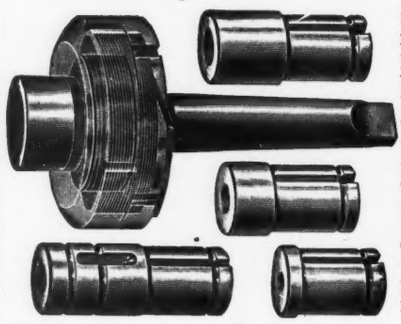
Send for the circular.



NIELSEN - BARTON CHUCK COMPANY

106 SO. JEFFERSON STREET
CHICAGO, ILL. U. S. A.

The Safety Drill and Tap Holder



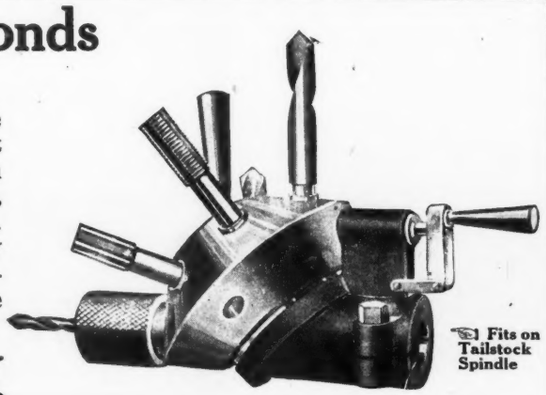
is the only attachment for the purpose that gives universal satisfaction and is unequaled in efficiency, convenience, rapidity, accuracy and simplicity. Nothing to break or get out of order. Made in 4 sizes, covering from 0 to 2½ inches diameter.

The Beaman & Smith Co., PROVIDENCE Rhode Island

A Turret Lathe in 15 Seconds

Here's the Recipe

Add one Newman Tailstock to any ordinary engine lathe. Result, a modern, efficient, quick acting turret lathe. Shops large and small are using the Newman Turret with excellent results. Centers, drills, reams, taps, etc., up to 1½" diameter. 10 days' free trial. Newman attachments increase output as much as fifty per cent. Catalog M gives details and describes a number of other labor-saving tools and attachments. Write for it today.



NEWMAN MFG. COMPANY

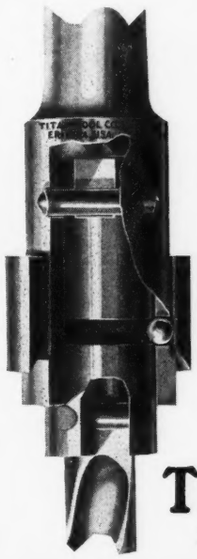
717 SYCAMORE STREET CINCINNATI, OHIO

Looking into the

TITAN CHUCK

A Chuck of Proven Merit

Makes possible the use of straight shank drills replacing the more expensive taper shank drills. Few parts and simplicity of construction is the key note.



All parts hardened and ground with liberal wearing surface.

Ideal for multiple or close range drilling.

Made in two sizes ¼ and ½ maximum capacity.

A trial order will convince you.

Titan Tool Co.
ERIE, PA., U. S. A.



The Chuck That Never Slips.

The More You Crowd It,

The Tighter It Grips.

NARRAGANSETT MACHINE CO.
PROVIDENCE, R. I., U. S. A.

If You want the best Lathe or Drill Chucks—buy Westcott's

Little Giant Auxiliary Screw Drill Chucks, Little Giant Double Grip Drill Chucks, Little Giant Improved Drill Chucks, Oneida Drill Chucks, Spur Geared Scroll Combination Lathe Chucks, Scroll Combination Lathe Chucks, Spur Geared Scroll Universal Lathe Chucks, IXL Independent Lathe Chucks, Cutting-off Chucks.



Spur Geared Scroll Combination Lathe Chuck

Strongest Grip, Greatest Capacity Great Durability and Accuracy

WESTCOTT CHUCK CO.
ONEIDA, N. Y., U. S. A.

Ask for Catalogue

SKINNER DRILL CHUCKS



THE mechanic's judgment is reflected in the tools he uses.

Mechanics like to use Skinner Drill Chucks because they are easily and quickly handled; there are no exposed gears or screws. It is the only chuck made with all the gears beneath the surface. The strong, powerful jaws grip the drill firmly, prevent wobbling and insure better work.

Skinner Chucks hold true, do not injure the shank of the drill Known for accuracy, capacity and durability.

Skinner Drill Chucks cost more because they are built right.

May we help solve your chuck problems?

THE SKINNER CHUCK CO.
NEW BRITAIN CONNECTICUT

New York Office: 94 Reade Street
San Francisco Office: Rialto Building
London Office: 139 Queen Victoria St., E. C. 4

"DOUBLE-GRIPP" Safety Tap Chucks

Help Secure Accuracy in Safety Signal Devices

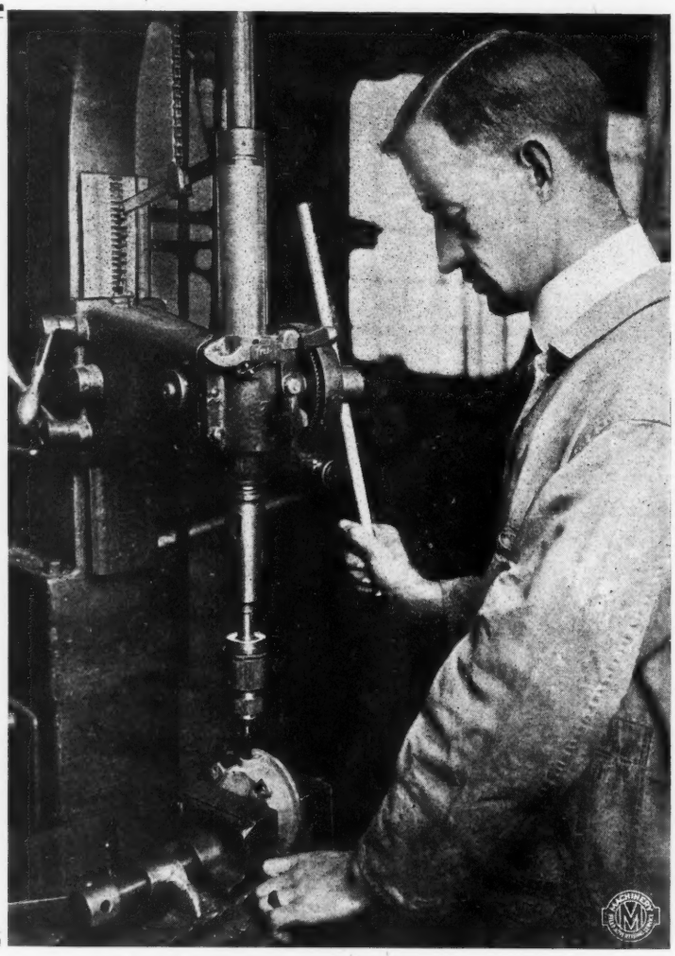
This photograph was taken in the shops of the American Gas Accumulator Co., Elizabeth, New Jersey, builders of Signal Devices, Lighthouse Flashing Mechanisms and Gas Regulators.

Work of this class demands extreme accuracy in every operation; in the one shown—tapping a straight ¼" thread in a bronze housing for an acetylene gas regulator—this is assured by the use of "Double Gripp" Tap Chucks to drive the tap true without forcing and without danger of breakage.

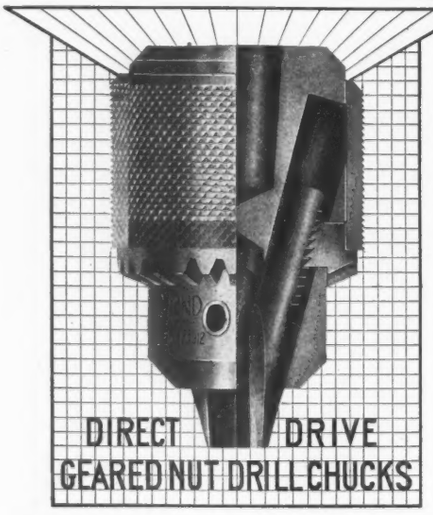
Where accuracy is important, where production time and costs are counted —use "Double Gripp" Tap Chucks.

Circular?

WILLIAM L. PROCUNIER
18 South Clinton St. Chicago, Illinois



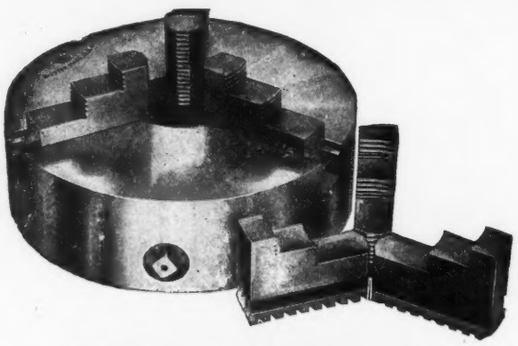
ALMOND



Teeth cut on nut giving *Direct Drive* and hardened steel Pinion Bushings which prevent wear are exclusively Almond features and insure long life.

Other **ALMOND** *Products:*
Lathe Chucks, Right Angle Transmissions, Micrometer Calipers, Flexible Steel Tubing.

T. R. ALMOND MFG. CO.
ASHBURNHAM MASSACHUSETTS



T-W CHUCKS

Wherever chucks are used you will find the T-W; because they have made good.

T-W policy; quality first, they cost no more than others.

If your dealer cannot supply you, we will.

Write now for catalog.

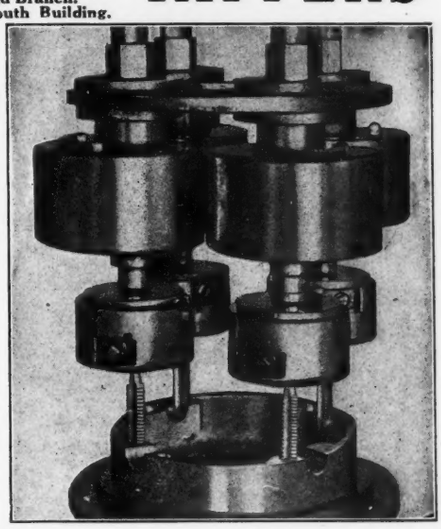
TERKELSEN & WENNBERG
326 A Street BOSTON, MASS.

ERRINGTON MECHANICAL LABORATORY

41 Cortlandt St., New York
Western Branch:
136 W. Lake St., Chicago
New England Branch:
831 Old South Building.
Boston,
Mass.

Catalog Francais:
Edgar Bloxham,
Paris
12 Rue du Delta

MULTIPLE TAPPERS



ERRINGTON TAPPERS reduce tapping costs to the minimum, insure exact duplication of work, are simple, compact and long wearing. Taps up to 5/8" can be used with only 2¼" between centers, and larger sizes are proportionately compact. In the job shown in the engraving 2560 3/8" holes were drilled and tapped in malleable iron gear cases in eight hours. Let us figure on your line of tapping.

Errington Opening Die Heads; Collapsing Taps; Opening Stud-setter; Friction Stud; Nut and Screw Setters, etc.

NO KEY—NO SLIP
LONGER LIFE

Just insert a drill by hand—it will tighten itself—Remove it the same way.
THOUSANDS AND THOUSANDS are giving satisfaction.

ARE YOU USING THEM YET?

EASTERN TUBE & TOOL CO.
Incorporated
Brooklyn, N. Y.



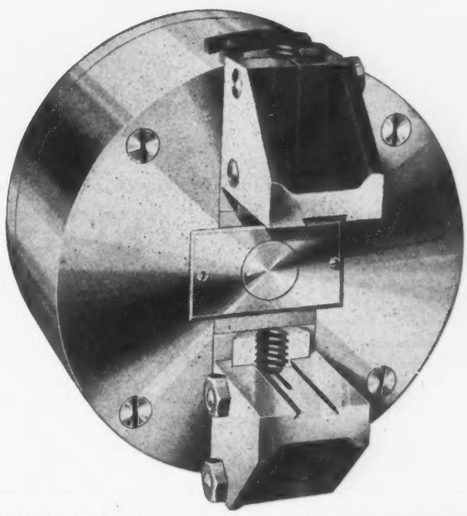
Do it today

The
ETTCO DRILL CHUCK

Boosts Production 25 to 90 Per Cent.

Reduces Machining Cost 25 to 50 Per Cent

M. E. C.
AIR-OPERATED CHUCK



An M. E. C. insures a constant, powerful hold; permits chucking and releasing much work without stopping the machine spindle; it has speed, durability and economic features that quickly help to show profitable returns to the user.

An example: An ordinary TURRET LATHE equipped with an "M. E. C." AERO CHUCK and up-to-date TOOLS, delivers a greater volume of product at less cost than an AUTOMATIC MACHINE.

Moreover, the initial cost of an AUTOMATIC MACHINE being many times greater than that of a TURRET LATHE, plus the cost of maintenance together with expensive tools, not infrequently absorbs any gain in production.

These cold facts coupled with the limit governing brass cutting speeds on AUTOMATIC MACHINES, makes its cost practically prohibitive. Solve your problems with the M. E. C.

Upon request we will gladly furnish additional data and drawings.

Manufacturers Equipment Co.
Waller Ave. and Fillmore St., Chicago, Ill., U. S. A.
NEW YORK OFFICE: Grand Central Palace, New York City

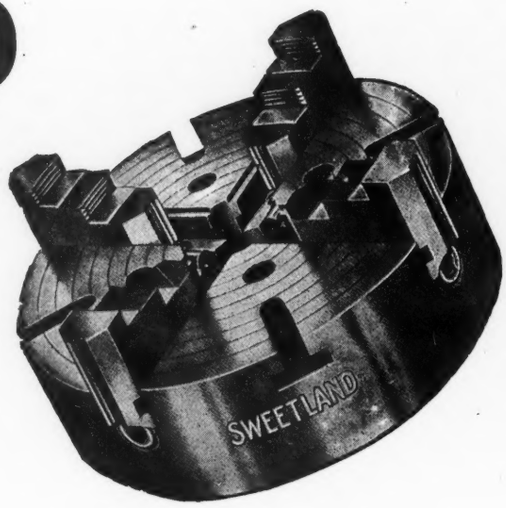
AGENTS:
West-Fisher-Bulwitt Co., Vernor Bldg., Detroit, Mich.
William K. Stamets, Jenkins Arcade Bldg., Pittsburgh, Pa.
William K. Stamets, Hickox Bldg., Cleveland, Ohio.
R. A. Braunberger Tool & Machinery Co., Machinery Hall Bldg., Chicago, Illinois.

SWEETLAND
Lathe Chucks

"What's In a Name!"

If it's a matter of chucks and the name is Sweetland there's profit in the name. Strong, rigid, accurately constructed, Sweetland Chucks can be trusted with the toughest job in the shop. They last longer because strain comes over the dovetail and not on the screws.

There's a Sweetland Chuck for every need guaranteed to the limit.



Write for Catalog 12C

HOGGSON & PETTIS MFG. CO., New Haven, Conn.
CHUCKS—DIES—STAMPS—TOOLS



Try this one

For a Sturdy Drill Chuck

No drill slipping nor spreading with this Hartford Drill Chuck. Once you set your tool to work every ounce of power will be delivered into the tool.

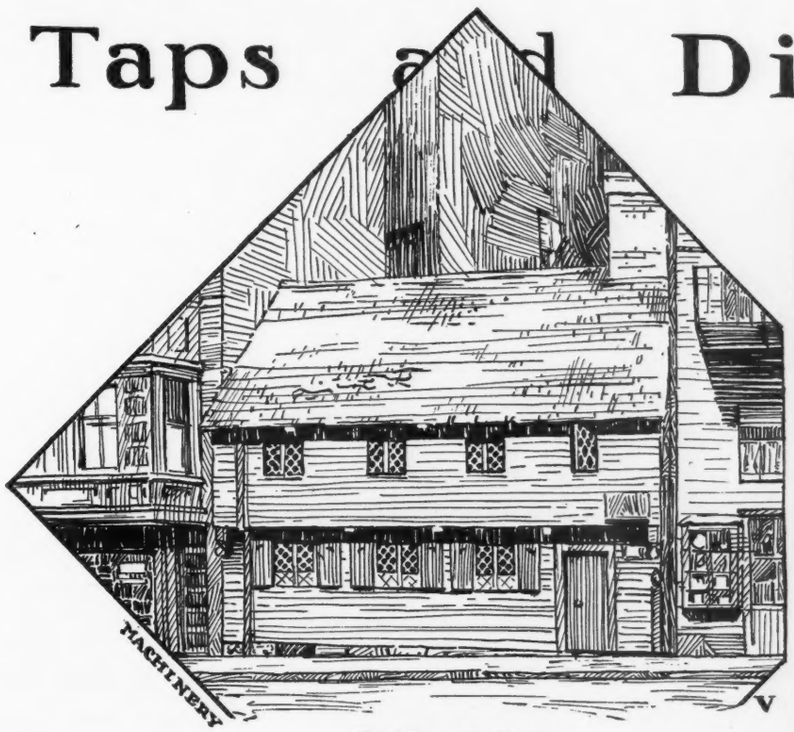
Our pocket size booklet describes the Cushman Line completely Send for it.

CUSHMAN CHUCK CO.
HARTFORD, CONN.

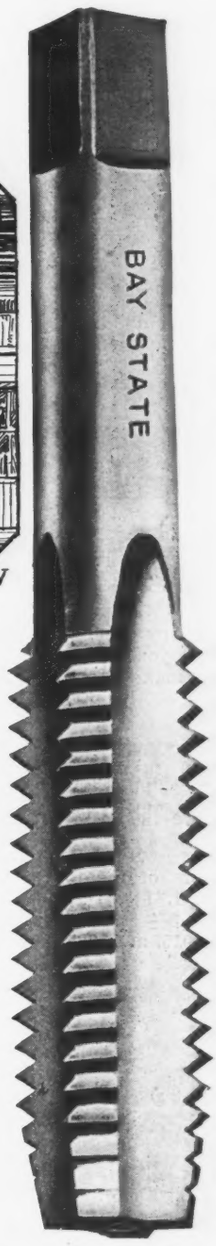
The Hartford Drill Chuck

BAY STATE

Taps and Dies



Paul Revere's House
Boston Mass.



The Utmost in Thread Cutting Equipment

Few landmarks in Boston are of greater interest than the house of the hero of the famous ride—Paul Revere. Standing in one of the city's most crowded quarters, it is a reminder to the people of today that those who went before, played their part in the upbuilding of America.

Could the visions of our forefathers have bridged the gap of time, what changes they would have seen; the country bigger and better—their state a leader in one of the most important of all mechanical industries—the production of tools. *"Bay State."* We chose our name with as great care as we give to the products which bear it. Bay State Taps and Dies are the utmost in thread cutting equipment. Specify *"Bay State"* with confidence.

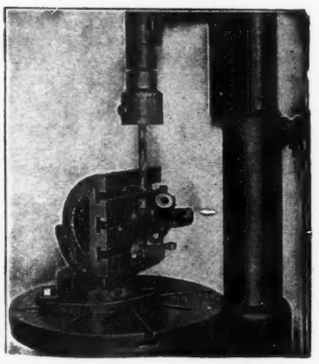
BAY STATE TAP & DIE COMPANY

MANSFIELD, MASS., U. S. A.

Representatives for England: Goodchild & Partners, Ltd., 56-58 Eagle St., Southampton Row, London, W. C.; Representatives for Scandinavia: Wilh. Sonesson & Co., Ltd., Malmo, Sweden.

Shop Economy and Production

No need to drive to the limit of what men and machines can stand; that will do for a "rush," but production isn't permanently increased that way. Shop economy is mostly a matter of clipping away waste motion.



The Universal Angle Plate



12 x 18

is very rigid, easily adjusted to various angles, gets the most out of time—two operations or a dozen, only one setting is required. Motion through 360° horizontally, 90° vertically, adjustable to 5 minutes or closer. Adapted for lathes, planers, millers, grinders, etc., and for grinding tapers and formed cutters.

Four sizes.
Write for particulars.

BOSTON SCALE & MACHINE CO.

100 Ruggles Street **Boston 20, Mass.**

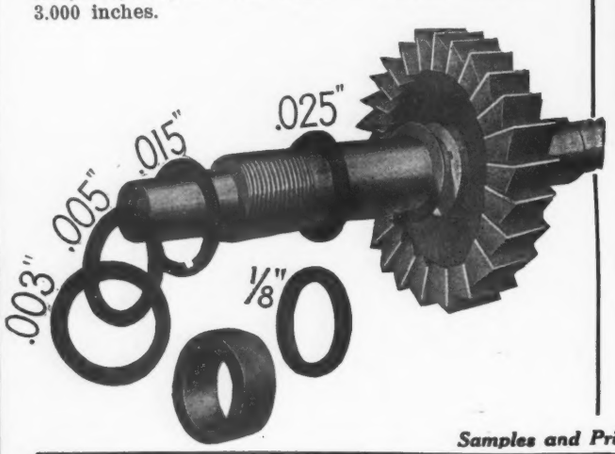
Agents for Great Britain: **Alfred Herbert, Ltd., Coventry, England also for Belguim, Italy, India, Japan, Korea and Ceylon.**

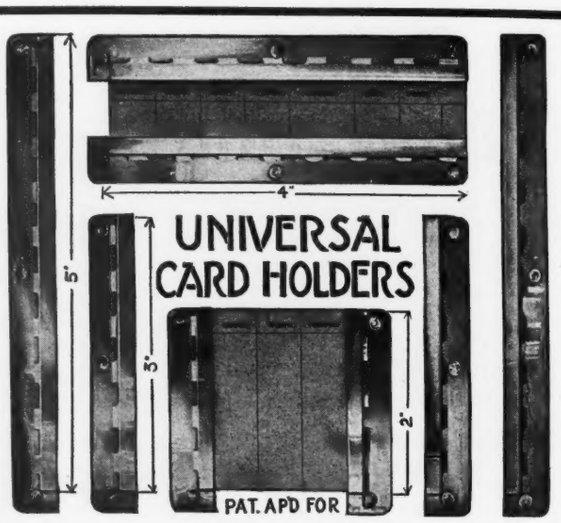
When you buy special tools and accessories from a specialist you get better tools at less cost than when you make them yourself—even such small items as

SPACING WASHERS

To Prove This, Try Ours on Your Next Order

Stock sizes—with or without standard keyways—for arbors of the following diameters: ⅜, ½, ⅝, ¾, ⅞, 1, 1⅛, 1¼, 1⅜, 1½, 1⅝, 1¾, 1⅞, 2, 2¼, 2½, 3, 3½ and 4 inches. Stock thicknesses: .003, .005, .015, and .025 inches. To order, .0015 to 3.000 inches.





Card holders for stock bins, shelves, trucks, stock boxes, etc., are another small but important commodity more economically manufactured by people in that line of business.

Universal Card Holders

are adaptable for cards of various proportions, can be used in either vertical or horizontal position and permit the use of almost the entire card which can be readily inserted and removed.

Four sizes in stock—2, 3, 4 and 5 inches. Other sizes to order. We now make these in two styles.

Samples and Price Lists on Request

DETROIT STAMPING COMPANY

951-957 West Fort Street
DETROIT, MICH., U.S.A.

DETROIT TOOLS

High Speed Reamers, End Mills, Cutters, Three- and Four-Flute Drills

No matter how large or small your needs, we're here to serve you. We carry a very large and complete stock. Standard Size Tools ready for immediate shipment; Specials to order in record time. Write or wire for quotations.

Catalog "A" lists the line.
Get it for your files.

THE DETROIT REAMER & TOOL COMPANY

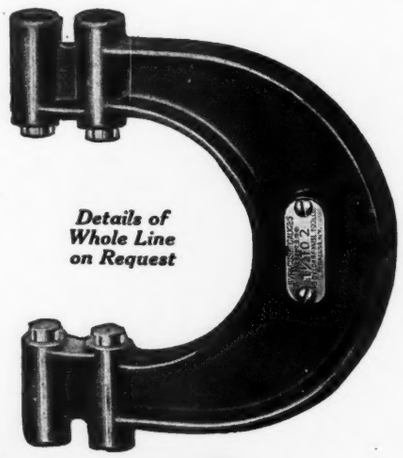
DETROIT MICHIGAN



SYRACUSE GAGES

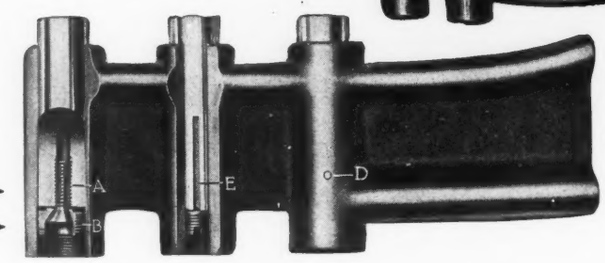
One Positive Adjusting and Sealing Point

A simple, foolproof method of setting and sealing Syracuse Gages is among the features that recommend them to busy manufacturers. To change the size the tapered head lock screw (a) within the split adjusting screw (b) is loosened and the plug set by moving the adjusting screw in and out. When the lock screw is tightened, the taper expands the split screw and locks both securely.



Details of Whole Line on Request

IMPROVED LOCKING MECHANISM



A Regular Feature of All Syracuse Gages

No exposed screws or seals and no possibility of gages being tampered with after inspection.

MESSENGER - SIMSON - GREENER - LOWRY

SYRACUSE COMPANY, INC. NEW YORK



IDEAL PARTS

Are Built for

ACCURACY–SERVICE DURABILITY

LOOK AT THAT HEAD AND CAM. They are made from the best material obtainable, carefully selected for the duties they must perform, hardened, and ground accurately to size.

These two parts must stand the greater part of the wear and tear in the Die-head and must therefore be solidly constructed. You will see that this fact has not been overlooked.

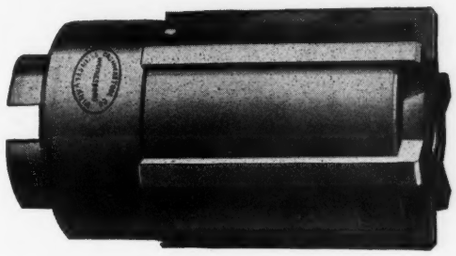
THERE IS GOOD SOLID CONSTRUCTION AND BACKING AT EVERY WORKING POINT.

Watch for next month's ad
Catalogue on request

IDEAL TOOL & MFG. CO.

BEAVER FALLS PA., U.S.A.

CASHMAN
ADJUSTABLE
SHELL REAMER



A Practical Tool That Cuts Costs

This time-saving device is simple in design and durably constructed, keen cutting, accurate and a big producer.

Blades are readily adjusted to .0001" by means of adjusting screw or lock collar. Stock sizes, 1" to 6½" diameter—larger on order.

Details in catalog "A"

CASHMAN TOOL COMPANY
WAYNESBORO, PENNSYLVANIA, U. S. A.

ONE OSGOOD OUTWEARS
Twenty Common Wood Handles



There is real economy in buying Osgood Tool Handles. A steel tube inside reinforces the wooden handle and holds the tool so it cannot pull out. Made in various sizes. Write for quantity prices, or see them at your dealers.

J. L. OSGOOD TOOL COMPANY
43-45 PEARL STREET BUFFALO, N. Y.

ROGERS

TOOLS



Reamers
Measuring Standards
Adjustable Hollow Mills

The John M. Rogers Works, Inc.
Gloucester City, N. J., U. S. A. 1865-1920

F F

TRADE MARK

FISKE'S
LUBRICANTS
Standards in QUALITY for over half a century

Do you know FISKE'S CUTTING AGENTS for IRON and STEEL have been developed to successfully displace straight Lard and Mineral Lard Oils—giving equal and even superior results while materially reducing the cost of operations?



Getting Ahead

This is just what FISKE'S CUTTING AGENTS for IRON and STEEL are doing—getting ahead. If you are not already using these proven products, the desired maximum satisfaction and results from your cutting operations have not been attained.

Our folder is interesting

Fiske Brothers Refining Co.
24 State Street New York City
PLANTS:
NEWARK, N. J. TOLEDO OHIO

F F

GRANT GEARS

IRON, FIBRE, STEEL, BRASS, RAWHIDE

Grant experience covers every phase of gear production; Grant facilities are equal to any demand; Grant deliveries are prompt, and most important just now, Grant prices are right.

A dependable source of supply, from which uniform gears may be had at any time, is an asset for any smooth-running plant. Grant Gears will keep yours going without a hitch.

Ask for latest catalogue

GRANT GEAR WORKS

151 PEARL STREET, BOSTON, MASS.

MP REG.

MEISEL

"Come Again" Gears

The rock-ribbed proof of satisfaction is the order for more.

More Meisel gears are being sold on the re-order than ever before. They are gears of uniform quality; gears *you* can rely upon for faithful performance; gears you will buy again and again. Used in tractors, machine tools, airplanes — wherever good gearing is in demand. Try them.



We do Heat-treating, Broaching, Case Hardening, Contract Work, Splining, Tooth Rounding, Internal and External Grinding and Screw Machine Work up to 5½" diameter.

Write for estimates.

MEISEL PRESS MFG. CO.
948 Dorchester Ave.
BOSTON MASS., U. S. A.

FORGED GEAR BLANKS

Speeds are so high, loads so heavy and time so precious, you can't afford to take chances any more: you must *know* that every item of equipment can stand the gaff.

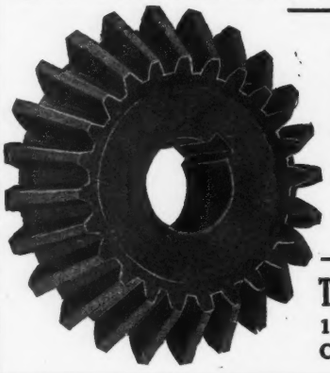
Forged gear blanks are stronger and far more durable than castings, more uniformly dependable than blanks cut from bar stock.

You need them to insure safe and profitable production. *We* make them in any quantity and to any specifications.

Let us estimate on your requirements.

THE MACHINERY FORGING CO.
Hamilton Ave. and Marquette Street
CLEVELAND, OHIO

CINCINNATI GEARS



Reduce friction in the driving mechanism. Carefully designed, accurately made, scientifically heat treated—dependably uniform always.

Write for Catalog C.

The Cincinnati Gear Co.
1825-1841 Reading Road
CINCINNATI OHIO

HERRINGBONE CUT GEARS

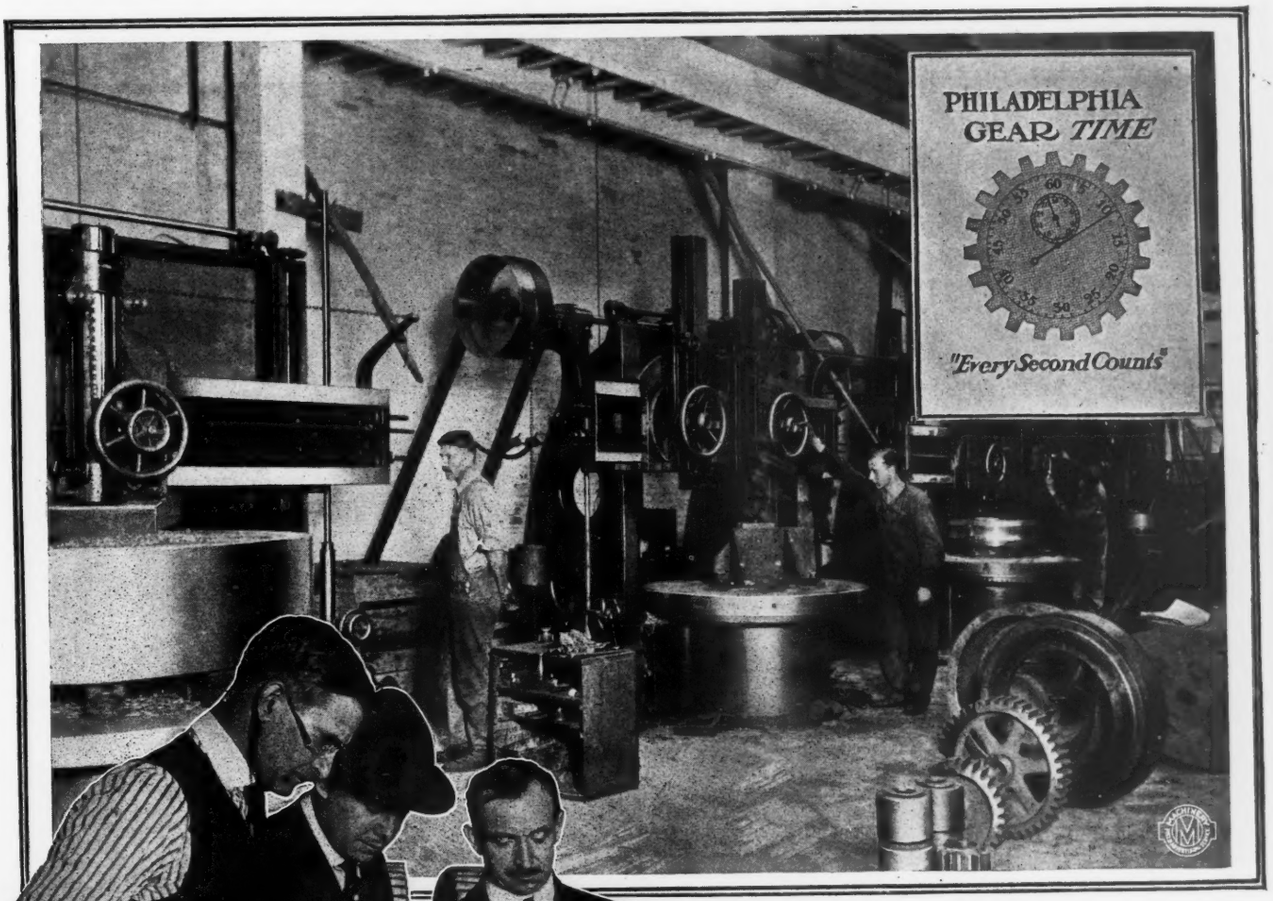
MILL DRIVES SPEED REDUCERS — FAWCUS — SPUR WORM BEVEL GEARS

FAWCUS MACHINE CO. PITTSBURGH, PA.

Hindley Worm Gearing

Complete drives with housing ready for power

ALBRO-CLEM ELEVATOR COMPANY
501 Erie Avenue, East PHILADELPHIA, PA.





Co-operation—*And* Phillie Gear Have Made Philadelphia Gears Famous

The photographer butted right into the midst of a family conference—Phillie Gear and two of his shop executives discussing a particularly intricate problem. Phillie Gear familiarizes himself with the details of every job that goes through. His lieutenants are all experienced mechanics, who know their men and machines and obtain best possible service from both.

Conferences among heads of departments and those next in command are regular "shop practice" in this plant. They insure the practical co-operation necessary to maintain the reputation of Philadelphia Gears.

Have you the Phillie Gear Catalog?

Philadelphia GEAR Works 1120-1128 Vine St Philadelphia

JONES GEARS



Made in All Styles and Sizes for Every Need

Orders for gears of every description can always be given to Jones with the assurance of their being properly filled. Our equipment is so complete and our capacity so great that all manner of requirements can be met.

Handling every operation as we do from the casting of the metal to the finished product, we depend upon no outside source for the proper filling of your order, and our delivery dates can therefore be relied upon.

Tell us your present requirements

WORMS, SPURS, BEVELS, HELICAL AND SPIRAL CUT GEARS,
PINIONS OF CAST IRON, CAST STEEL AND FORGED STEEL;
ALSO PINIONS OF RAWHIDE AND BAKELITE MICARTA.

W. A. Jones Foundry & Machine Co.
4409 West Roosevelt Road, *Chicago.*
New York 20 Murray St.

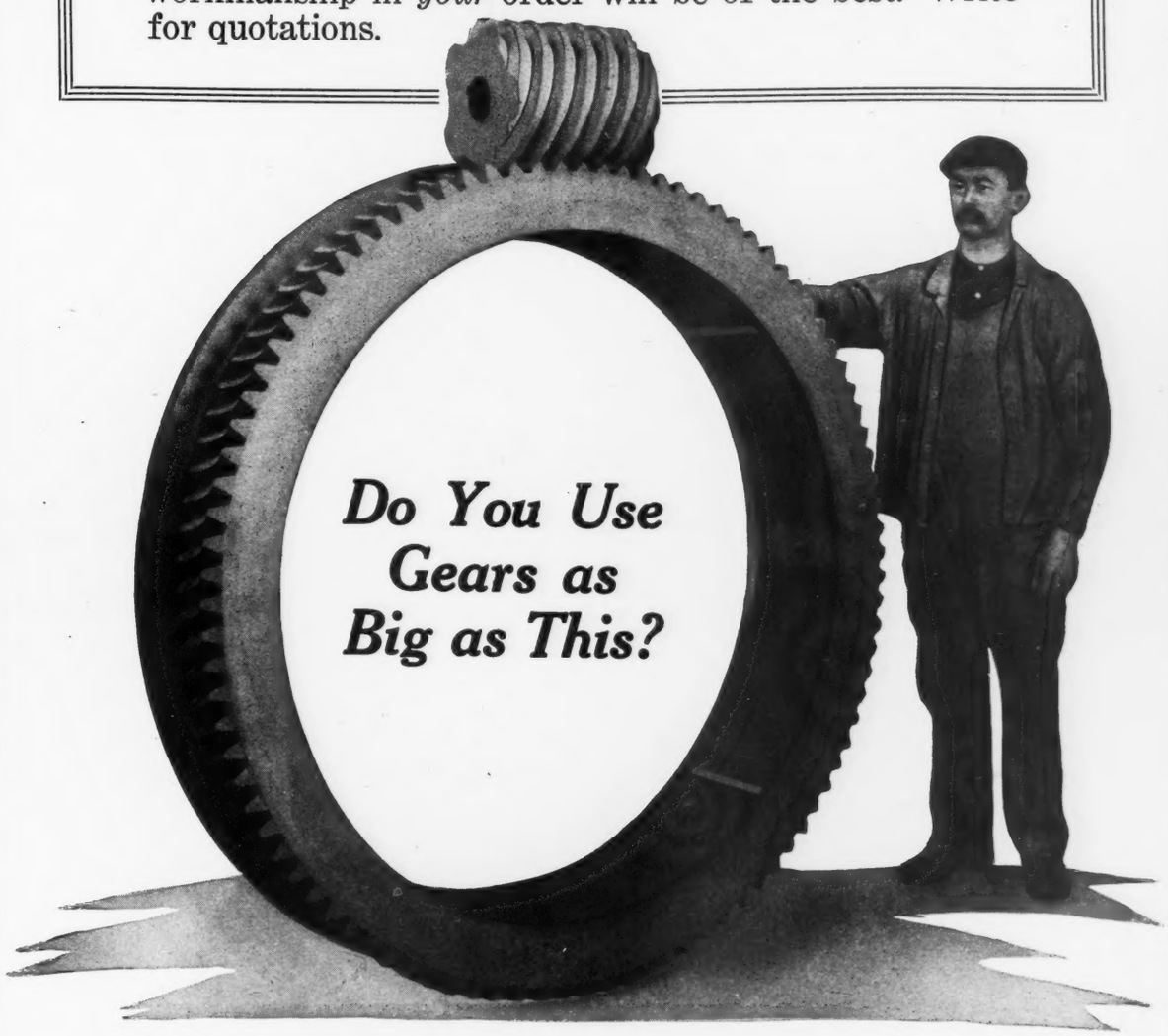
Manufacturers of cast iron pulleys, gears of all kinds, couplings, Lemley friction clutches, pillow blocks, hangers, speed reducers, and general power transmission machinery.

NEWARK

Gear Cutting Service

If your requirements call for gears of exceptional size, remember that we're fully equipped to fill your orders. We specialize in the cutting of large worms, odd size gears of all kinds and special shapes.

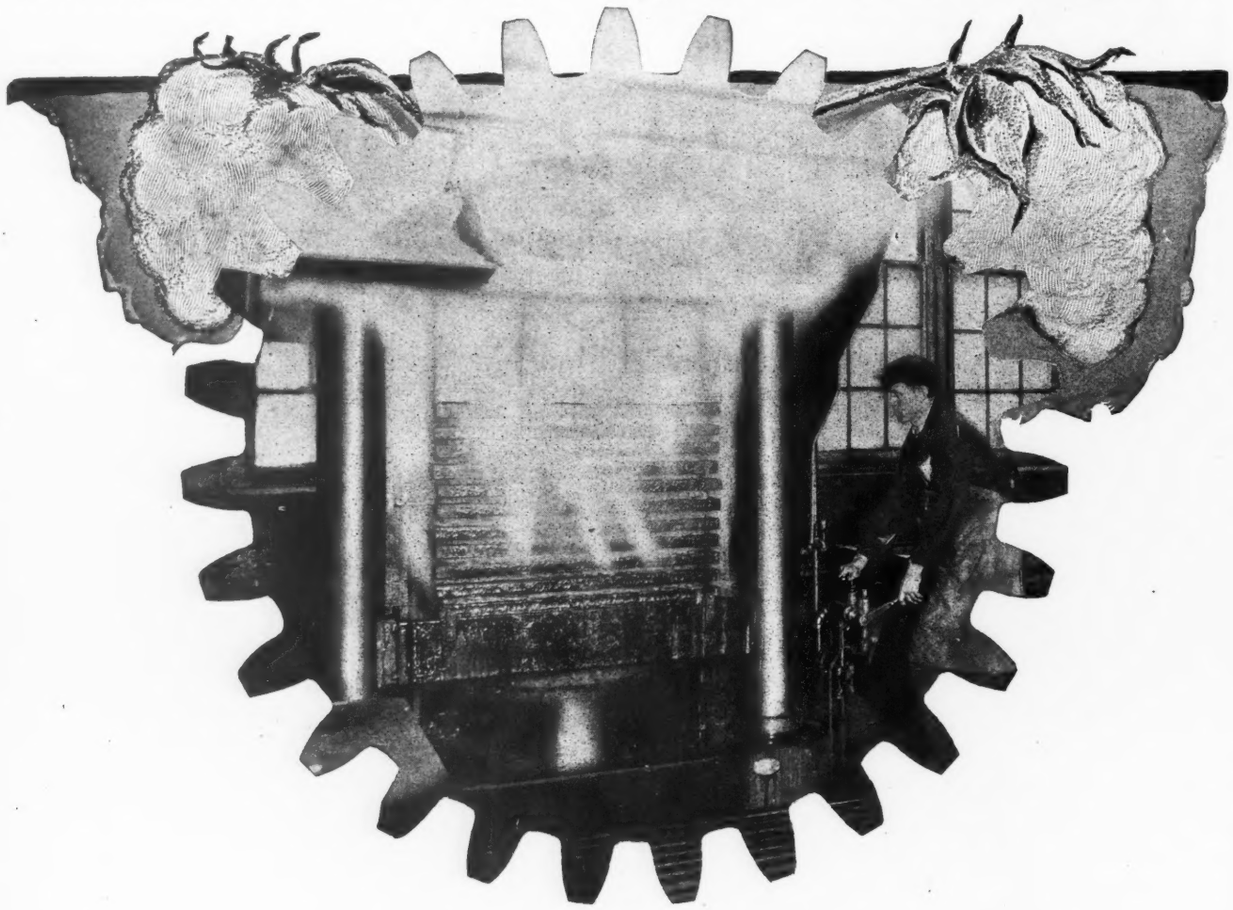
The men and equipment behind Newark gear cutting service give adequate assurance that materials and workmanship in *your* order will be of the best. Write for quotations.



NEWARK GEAR CUTTING MACHINE CO.

NEWARK HENRY E. EBERHARDT, President NEW JERSEY

Shock and vibration are responsible for much of the wear on machinery—lessen these and you lengthen the life of the machine.



A Pressure of Tons Gives Great Durability

The process illustrated here shows the compression and stiffening of the bat—the second step in the manufacture of a fabroil gear.

Fabroil gears are resilient enough to absorb shocks of starting, stopping and momentary overload—run equally well with cast iron, steel or bronze.

When contemplating the purchase of machinery, specify Fabroil Gears.

May we send you our gear bulletin 48703-A

General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

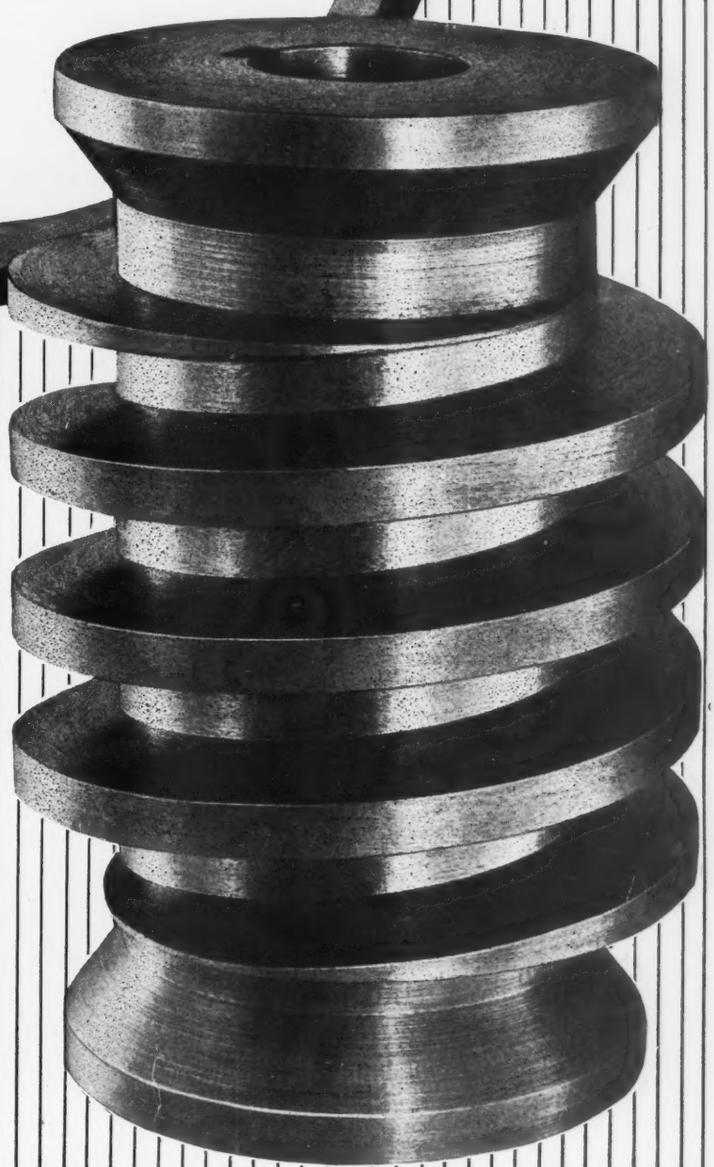
40-123

Peerless GEARS

Thirty years' experience in the manufacture of gears exclusively are back of Peerless Metal and Rawhide Gears.

Why not get the benefit of this experience by letting us make your gears? Bevel gears and spur gears from ¾" diameter to 15 ft. diameter. Worm, spiral, internal, herringbone gears and racks to your specifications.

If you buy gears, you'll want our "Blue Book on Gearing." Write for it today.

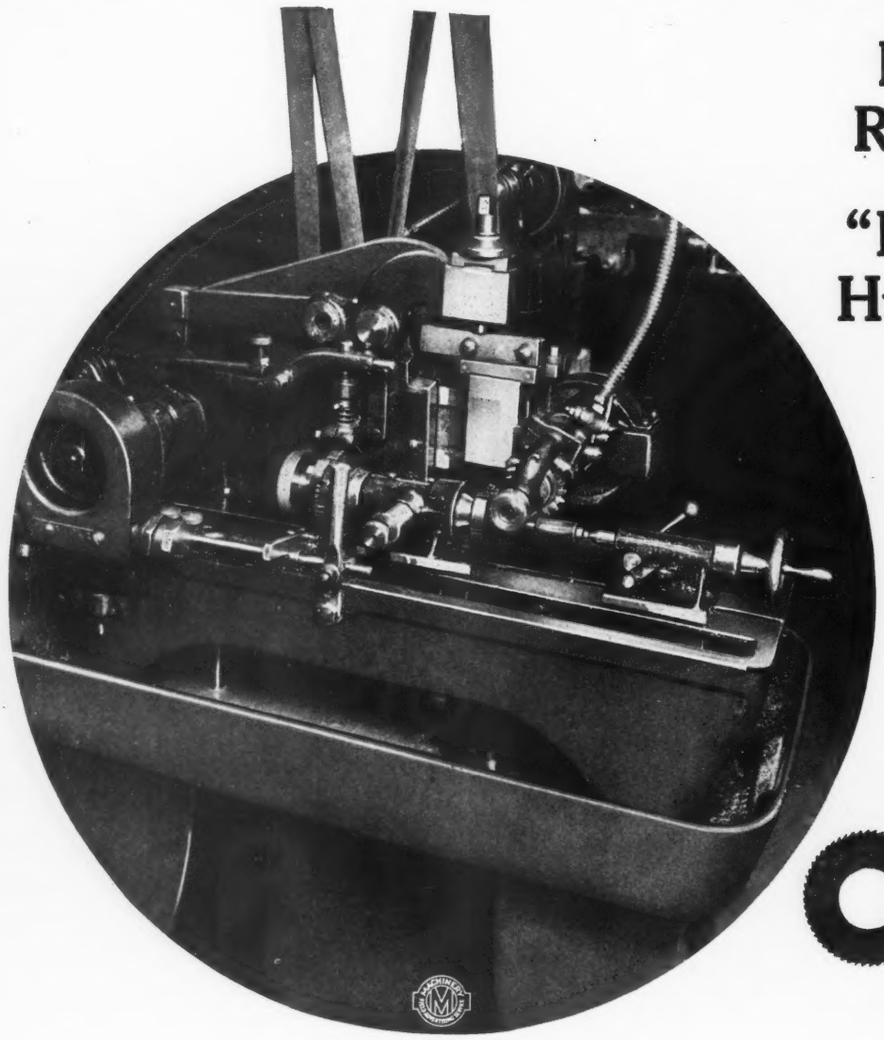


MEMBER OF AGMA

THE HORSBURGH & SCOTT COMPANY

CLEVELAND OHIO, U. S. A.

BILTON GEAR MILLERS

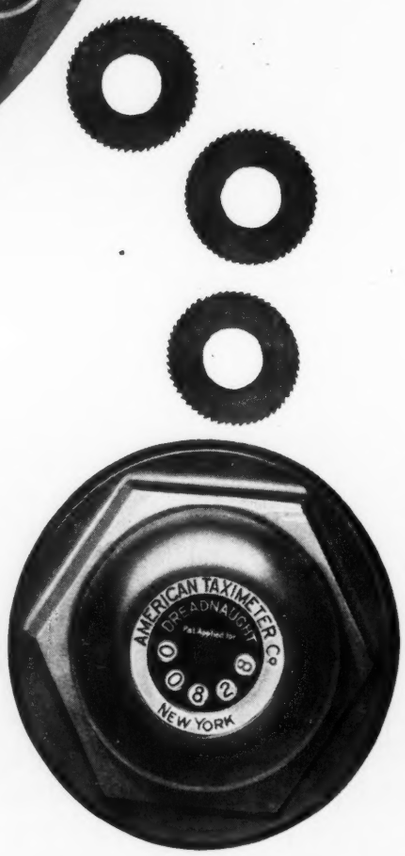


Milling Steel Ratchet Gears *for* "Dreadnought" Hub Odometers

Labor is high — don't waste it. Bilton Gear Millers enable operators to get top notch production at low cost.

Ask us what they can do on your work.

Catalog No. 20-G will interest you.

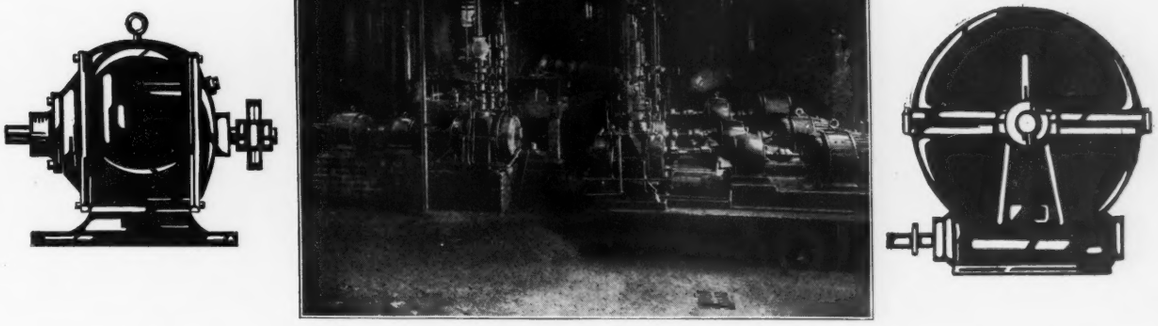


Measuring miles with the devices manufactured by the American Taximeter Co., is a sure-fire performance that is guaranteed for accuracy by the care with which they are designed and built.

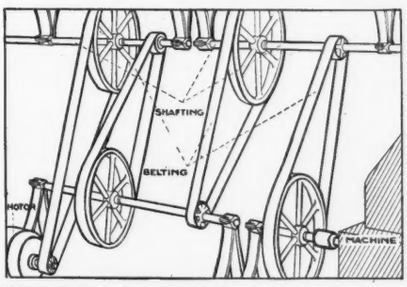
For instance—this Bilton Gear Miller, which is shown milling small Ratchet Gears for the Dreadnought Hub Odometer, insures both economy and accuracy on this operation. The ratchets are ¾" in diameter with a 1/16" face, and have 56 teeth. They are loaded onto arbors 22 at a time, and finished at the rate of 132 per hour; a production rate made possible by the automatic operation of the machine, which feature also enables the operator to prepare the work and to remove the burr from the pieces already cut, while the machine is in operation.

THE BILTON MACHINE TOOL CO.

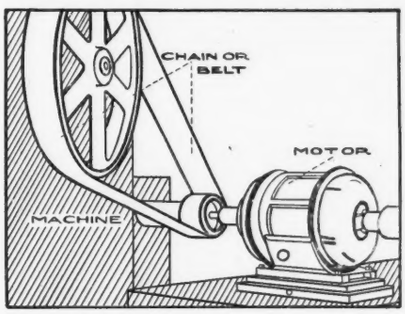
Bridgeport, Conn., U. S. A.



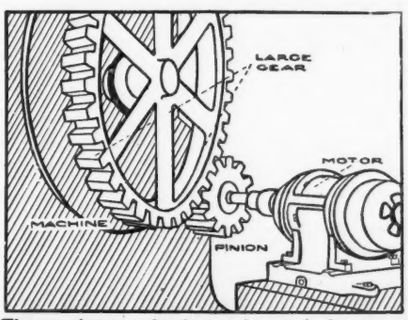
A battery of Foote Speed Transformers in use in the plant of the Republic Chemical Company, Pittsburgh, Pa.



Where belts are employed, slippage results, causing power loss, frequent replacement and repairs and when used with shafting utilize valuable space.



The use of a large and small gear to provide speed reduction causes friction, excessive wear and power loss, often resulting in production delays.



The use of open reduction equipment is dangerous to workers and costly to employers. Dust, dirt and grit cause undue wear on belts, chains, sprockets and open gears. And it is impossible to obtain as great reductions as with Foote Speed Transformers.

Foote Speed Transformers simplify motor speed reduction problems, save power, space, and replacement cost and provide positive safety for your workers.

Where a reduction greater than three to one is required, means of motor speed reduction such as the use of chains or belts driven direct from the motor or from shafting, large gears and pinion gears, are extremely wasteful.

Foote Speed Transformers are the recognized standard for reducing or increasing speeds of machinery without the use of line shafting and belts. They are made in types, sizes and speeds to meet any requirements.

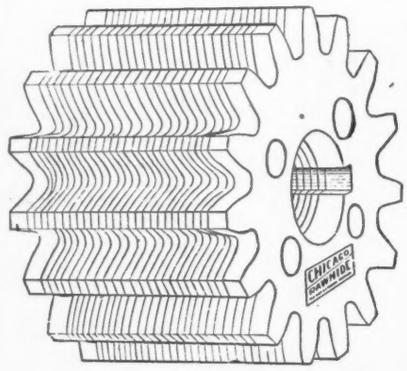
Foote Engineers have indicated better methods, safer means, greater economies of motor speed reduction for many of the largest plants in America. Foote Engineers may be able to show you how you can greatly benefit through the use of Foote Speed Transformers. Writing for advice puts you under no obligation.

Foote Bros. Gear & Machine Co.

Cut Gears of All Kind Made to Order
Send for Catalog

232-242 N. Curtis St. Chicago, U.S.A.

FOOTE SPEED TRANSFORMERS



THE ECONOMY OF RAWHIDE GEARS

In addition to making machines silent, Rawhide Gears minimize vibration, thereby prolonging life and effecting a great saving in the cost of repairs and renewals. It will pay you to investigate "Chicago" Rawhide Gears, for economy and silence.

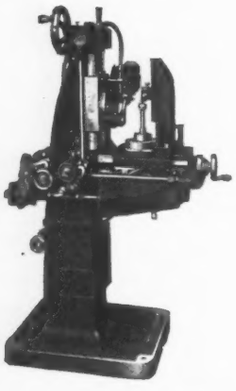
If made of leather for mechanical purposes—we make it.

We make Belting, Lace Leather and Cut Lacing, Hydraulic Packing, Rawhide Mallets and Hammers, Leather Specialties, etc., etc.

The Chicago Rawhide Mfg. Co. 1301 Elston Ave. CHICAGO, ILL.

THE GEAR HOBBER

They're All Talking About



WHEREVER it is known or used the Hercules Gear Hobber is recommended as a cost-cutter and production booster.

This machine is making good most decidedly.

It is earning repeat orders.

Let us send complete information.

Manufacturers of Tools of Precision for the Accurate Generation of Teeth.

Hercules Machine and Tool Co., Inc.
General Offices: Broome and Lafayette Streets, New York City. Works: Astoria, Long Island

STAHL GEARS

What Makes Good Gears?

Care in designing and manufacturing, high standards of accuracy, correct equipment and *experience.*

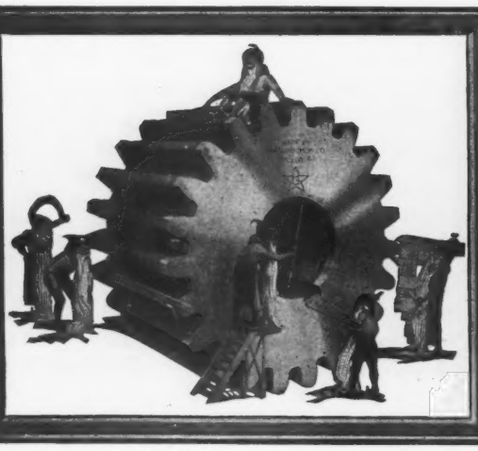
These are the qualities that combine to make Stahl Gears valuable in the construction of high grade machines.

Metal Gears—spurs up to 60" dia., 2 D.P.; bevels up to 24" dia., 1¾ D.P.; spirals and herringbone gears up to 19" dia., 3 D.P.; worms up to 18" dia., 3 D.P.; racks 8' long, 4 D.P. Rawhide gears—any requirement up to 15" dia., 2 D.P.



Have you tried Stahl Gears?

THE STAHL GEAR & MACHINE CO.
1390 East 40th St.
CLEVELAND, OHIO, U.S.A.



GANSCHOW

"QUALITY"
RAWHIDE AND BAKELITE
PINIONS
WILLIAM GANSCHOW COMPANY
CHICAGO ★ ILLINOIS



Gears

SPURS, BEVELS, MITERS, MORTISE WHEELS, WORMS AND WORM WHEELS

We have the most complete line of equipment in the U. S. A. for making machine molded cast tooth gears. With the machine molding system a single tooth block is used and all the teeth are accurately machine spaced, insuring gears that are free from the inaccuracies of pattern molded gears, at the same time eliminating a large part of the pattern expense.



Capacity 1 inch to 6 inch pitch, up to 20 feet diameter and 20 tons in weight.

CUT TOOTH GEARS

We make a complete line of ELEVATING, CONVEYING AND POWER TRANSMITTING MACHINERY.



H. W. CALDWELL & SON CO.
CHICAGO, 17th ST. and WESTERN AVE.
NEW YORK
50 Church St.
DALLAS, TEX.
709 Main St.

Buy Earle Gears for Economy

The life of a gear will depend to a large extent on the judgment displayed in selecting the material and formulating the design.

No one is better equipped to render this judgment than the expert gear maker—one whose *specialty* is the making of gears.

There is no charge for our advice on your gear problems. Write us.

THE EARLE GEAR & MACHINE CO.
4705 STENTON AVE. PHILADELPHIA

EARLE GEARS

Hindley Gears

Greater Bearing Surface—Larger Number of Teeth in Contact

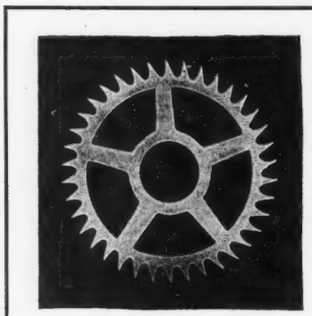
Heavy pulls and high speeds require gears of the greatest possible strength and durability. The record of Hindley Gears in hard drives proves their ability to negotiate any job in the service with safety to all concerned.

TRY THEM

39 Years on the Market



Hindley Gear Company
1105 Frankford Avenue Philadelphia, Pa.



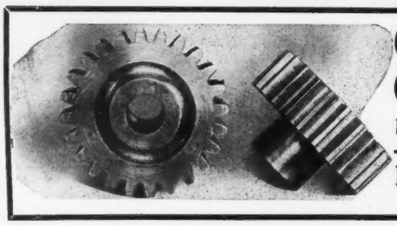
GENERATED
in our
Gear Cutting Department
(Cut is full size)

Let Us Quote You

MEISSELBACH-CATUCCI MFG. COMPANY
54 STANTON STREET NEWARK, N. J.



BEVEL GEAR GENERATORS.
BEVEL GEARS
CUT THEORETICALLY CORRECT.
Special facilities for cutting Worm, Spiral, Miter, Internal and Elliptical Gear Wheels.
The Bilgram Machine Works
1231 Spring Garden Street, Philadelphia, Pa.



Gears and Gear Cutting
We guarantee satisfaction
RODNEY DAVIS
PHILADELPHIA, PA.

DIEFENDORF

GEARS TO YOUR ORDER

We specialize in quality gears. Thirty years of practical experience your guarantee.

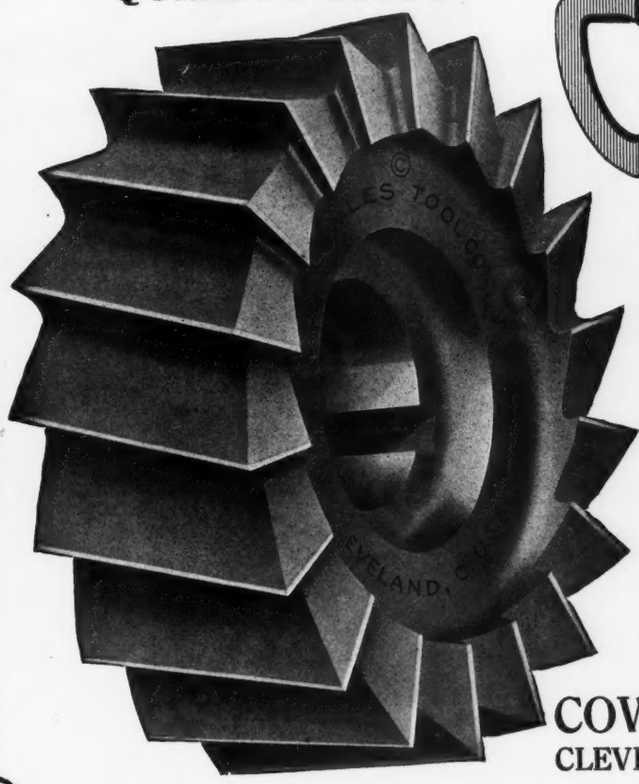
CAST IRON, STEEL, COMPOSITION

Write for estimate. You will find our prices right.

DIEFENDORF GEAR CORPORATION
Syracuse New York

AGMA

QUALITY FIRST



COWLES CUTTERS

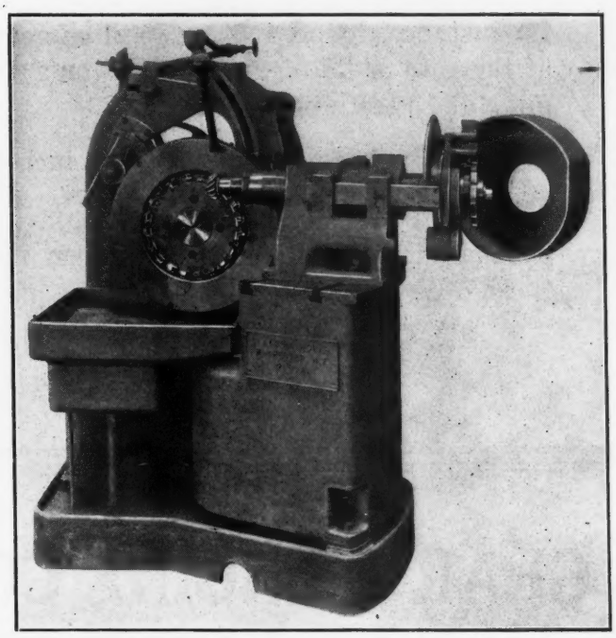
Do you believe in Specialization? We make nothing but HIGH SPEED STEEL MILLING CUTTERS. Our entire plant being concentrated on the one thing, enabling us to turn out a very high grade product. Cut shows one of the many styles we make.

Plain Milling Cutters	Convex Cutters
Side Milling Cutters	Concave Cutters
Interlocking Side Milling Cutters	Shell End Mills
End Mills	Metal Slitting Saws,
Angular Cutters	Inserted Blade Cutters
	Special Cutters

Many standard sizes carried in stock, prompt delivery on others. Write or wire for quotations

COWLES TOOL COMPANY
CLEVELAND OHIO, U. S. A.

Gleason Spiral Pinion Rougher



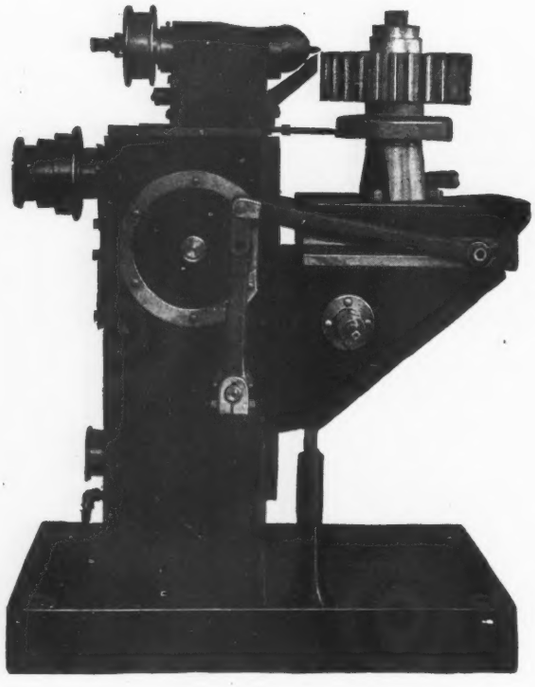
The Latest Machine

Has Many Improvements. Let us tell you about them.

GLEASON WORKS, Rochester, New York

CROSS

GEAR TOOTH ROUNDING MACHINE



The Cross Gear Tooth Rounding Machine is the original machine that allows the gear to be held rigid during the cutting operation and where the cutter spindle oscillates or rotates about an axis eccentric to its own axis of revolution. All other machines having this principle are direct infringements, and all manufacturers, sellers and purchasers of the same will be considered direct infringers and will be held liable to the full extent of the law.

Does Your Product Make Too Much Noise?

Noise absorbs energy—wastes it—for noise denotes friction. Undue noise in your product indicates neglect in its building. Whether you build machine tools, automobiles, engines, tractors, mill or other machinery—no matter what you make — grinding gears will give you away. Silence is always golden in moving machinery.

Cross Gear Tooth Rounding Machines in your plant will give these results with maximum economy. The "Cross" will, for instance, round a ⅝-or ⅝-pitch gear at the rate of 25 teeth a minute, or a ⅘-pitch at 15 teeth per minute.

Its capacity is for gears up to 36 inches diameter—2-pitch or finer.

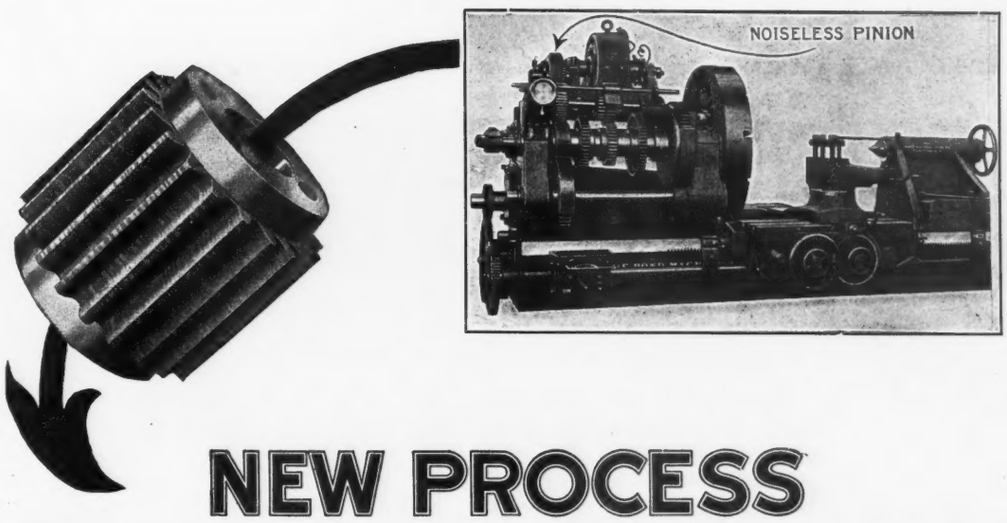
Further details will be mailed upon request. Write.

"Round Corners on a CROSS"

CROSS GEAR & ENGINE CO.

809 Bellevue Avenue DETROIT, MICH.

and on all types of Lathes—



NEW PROCESS RAWHIDE PINIONS

absorb the vibration that imparts a jerky motion to cutting tools and dulls their sharp edge quicker.

—their quietness reduces nerve strain

THE MEACHEM GEAR CORPORATION

Sole manufacturers of new process RAWHIDE GEARS and PINIONS.
Still made under the direction of the inventors and the men responsible for every stage in their development.

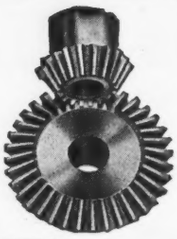
Canal Street and West Shore Railroad, Syracuse, N. Y.

49

STANDARDIZED BOSTON GEARS



300,000 in stock at factory.
Over 1200 sizes in our 1920 Catalog. Sent on request.



Look thru our Catalog before you order those expensive samples. You may save yourself a big expense.



BOSTON GEAR WORKS
Norfolk Downs, Quincy, Mass.

CHICAGO BRANCH
623-5 W. Washington Blvd.

"Zones of Quiet" GEARS



PERHAPS your product would be improved by the use of "Zones of Quiet" Gears. Their noticeable smoothness in operation and absence of harsh, grinding gear noises always attract favorable attention and mention of the finished article on which they are used. We make—

Spur, Helical, Bevel, Mitre, Spiral and Worm Gears and Worm Wheels in all metals—also in Bakelite.

Capacity—10,000 finished gears daily. If interested, send blue print or sample gear for estimate.

ALBAUGH-DOVER CO.
2100 Marshall Blvd., Chicago

MEMBER AMERICAN GEAR MANUFACTURERS ASSOCIATION

ALLEGHENY GEARS

Spur, Bevel, Mitre, Worm and Spiral Gears made in a wide range of sizes, designs and materials. Spurs to 60″ diam. 2 DP. Bevels and mitres 50″ diam. 5″ pitch. Equipped to manufacture Gears and Machine parts in quantities.



Our complete Heat Treating Plant enables us to perform Case-Hardening, Annealing and General Heat Treating Promptly and Scientifically. *May we estimate?*

ALLEGHENY GEAR WORKS
Gear Specialists
1000 Chateau St., N. PITTSBURGH, PA.

"TRY SIMONDS"

if you are in the market for

Cut Gears, Racks, Worms, Worm Gears, Special Machinery



Write

THE SIMONDS MFG. COMPANY
PITTSBURGH, PA., U. S. A.

VULCANIZED FIBRE

BE SURE AND SPECIFY

"WILMINGTON FIBRE"

SHEETS ROPE TUBES WASHERS, &c. SPECIALTIES

WILMINGTON FIBRE SPECIALTY CO., Wilmington, Del.
BRANCH OFFICES "EVERYWHERE"

HOLLOW BORED FORGINGS AND STEEL SHAFTS

Lathe Spindles, Piston Rods, Hydraulic Cylinders, Rams, etc.

If hollow steel shafts are needed in your equipment it will pay to consider a proposition from us.

American Hollow Boring Co., Erie, Penna.

FORGING SERVICE

Means performance, and we are performing to the satisfaction of a great many of the largest machine tool builders in the country. We can do the same for you right now.

If you use spindles, gear blanks, shafts, rings—in fact any kind of hammered forgings—we would like to figure with you.

Today is a good day to drop your specifications and blue prints in the mail addressed to

The Steel Forgings Company

CINCINNATI OHIO, U.S.A.

Dyson Forgings



Dependable Spindles for Big Machines

The right steel, correct heat-treatment, skilled workers and modern equipment, make Dyson Forged Spindles an asset to all machines that are built to last.

Forgings of all classes from 3-inch nuts to 5-ton shafts. Have you tried them?

JOSEPH DYSON & SONS

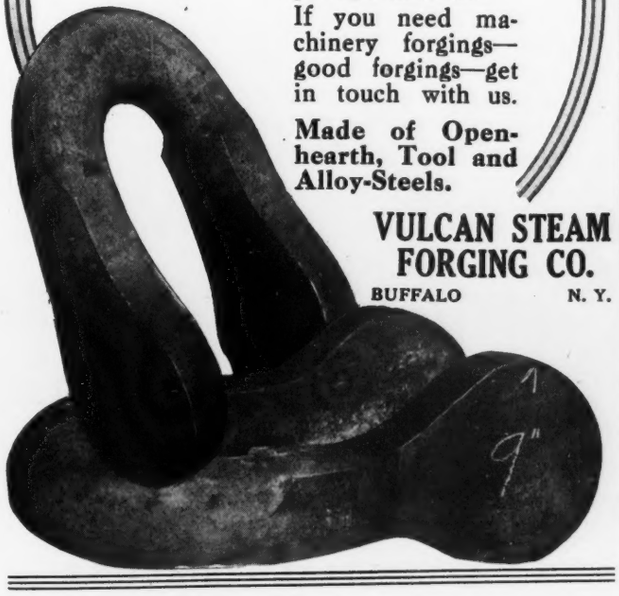
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ESF

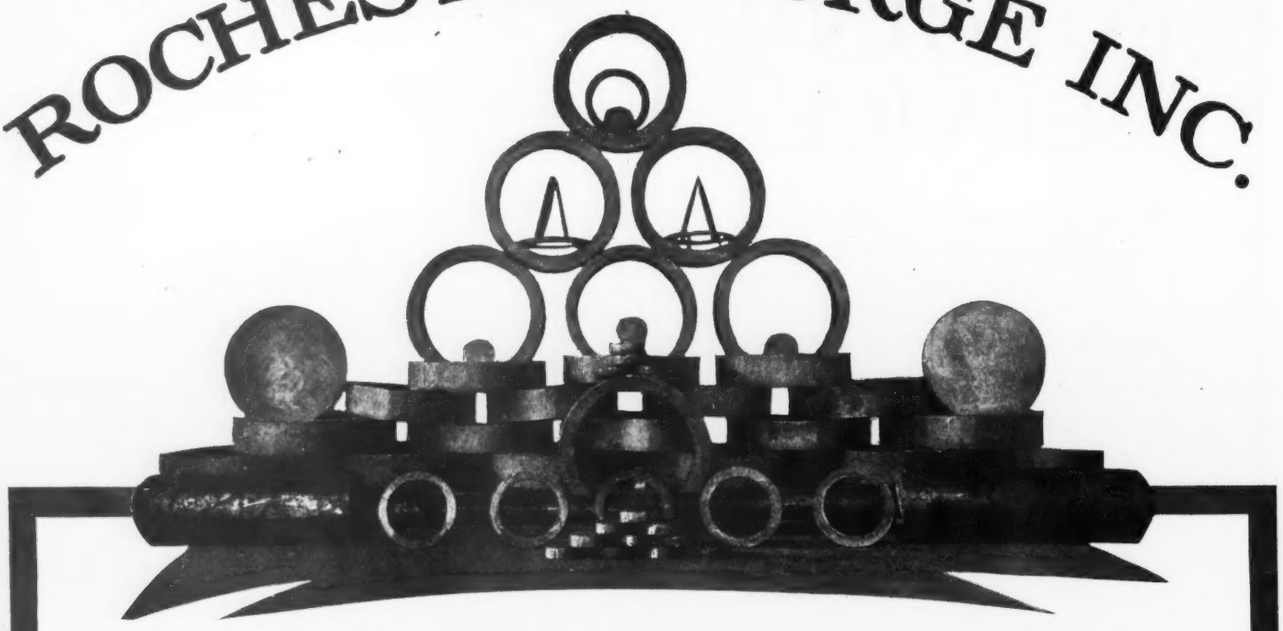
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Hollow forgings are the supreme test of forging skill. *Good* hollow forgings—i. e. concentric and close to finish dimensions—save appreciably on machining.

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For Milling Machines, Grinders, Gear Cutters, Lathes.



The Point only is changed

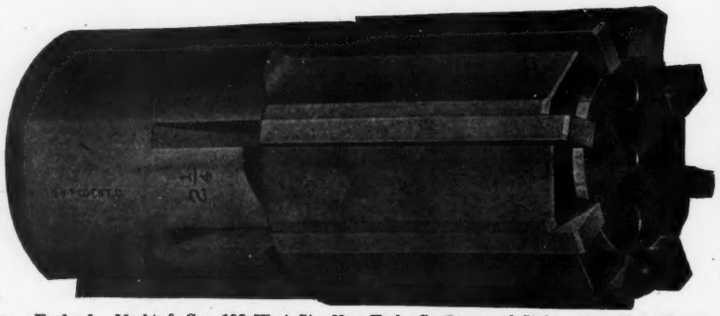
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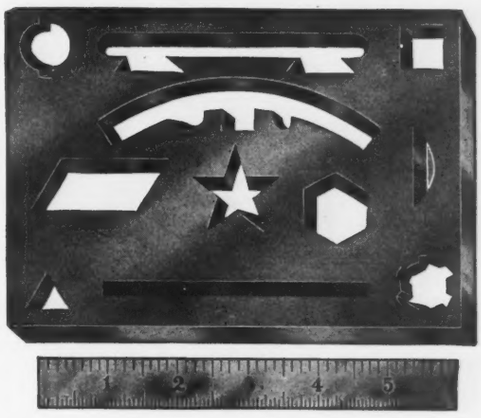
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BRUNO Attachments are

Extensively used in the most exacting shops and have been found to make possible the most intricate shaping, such as that required for Dies, Jigs, Gages, Keyways, Slotting, etc.

The attachment is simple in construction and quickly applied. The cutting tools may be made from round or square stock and may be turned to cut from any angle.



Photograph of a steel plate, one inch thick, machined with our slotting attachment. Note the sharp points of the star. Why file? You can quickly and accurately machine these shapes with our attachment.

Made in the following regular sizes. No. 0—takes 3/8″ to 1/2″ Round Shanks, No. 1—takes 1/2″ to 5/8″ Round Shanks, No. 2—takes 5/8″ to 3/4″ Round Shanks.

Each size is furnished with two cutting tools.

Dept. M.

H. A. MOORE CO.

ROCHESTER, NEW YORK, U. S. A.

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"Neither rusts, stains nor tarnishes"

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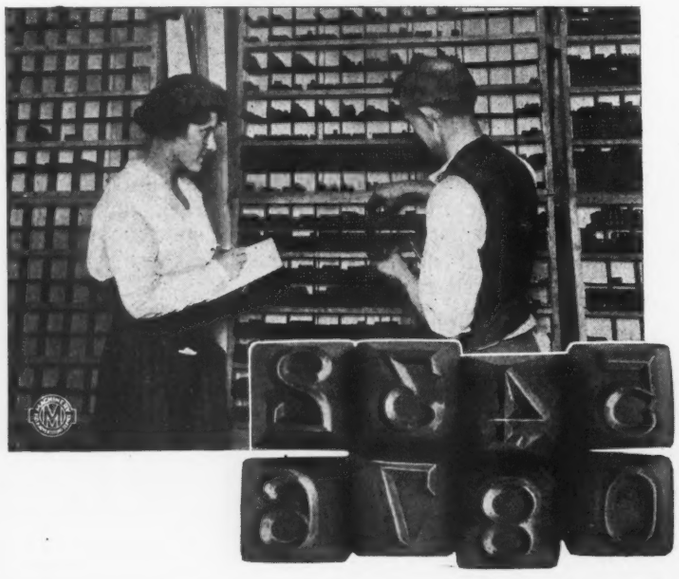
A high-chromium alloy steel (containing approximately .30 percent carbon and 13 percent chromium), whose most useful property is an exceedingly high resistance to the corrosive effects of acids and gases.

VALVES: In addition to its rust resisting and non-corrosive qualities, Stainless resists the oxidizing effects of hot gases to such an extent that it is particularly valuable for aeroplane and automobile engine valves, where it is replacing nickel and tungsten steels. Not only does it resist scaling to a marked degree, but its low co-efficient of expansion (.00001091512) is an asset. In practice, Stainless valves, used on the exhaust side of very high compression motors, thereby preventing too rapid "erosion" of the valve seat, have demonstrated that for this particular purpose, they are superior to tungsten steel.

Stainless Steel can be supplied in all standard sizes of round, square or flat bar steel. Also a few strip sizes.

AMERICAN STAINLESS STEEL COMPANY
1543 Oliver Building **PITTSBURGH, PA.**

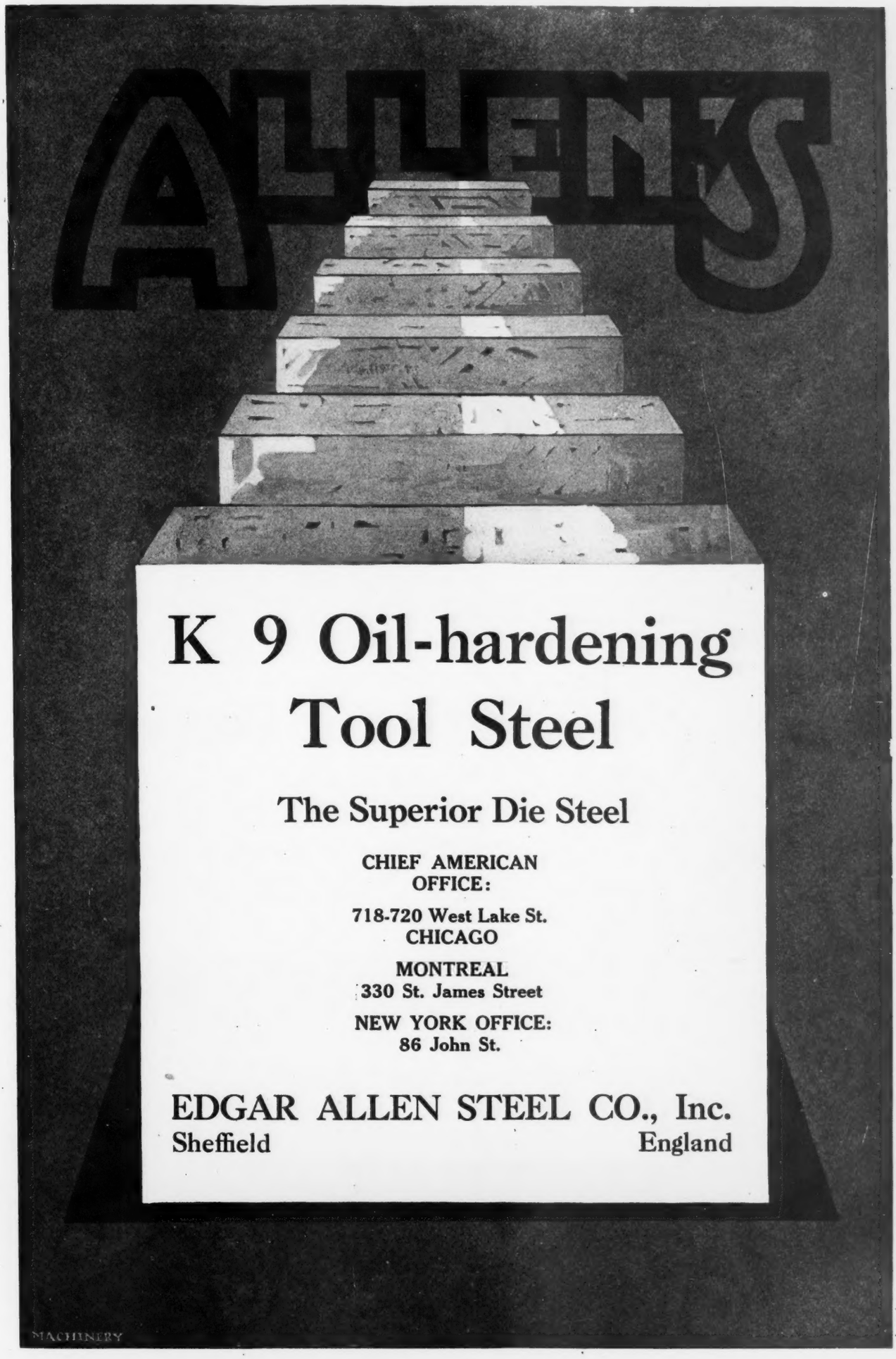
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The Nationally Known—First Quality

HIGH SPEED STEEL

The Best for All Machine Work

Are Your Tools Made of "Red Cut"?

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ACKLIN STAMPINGS

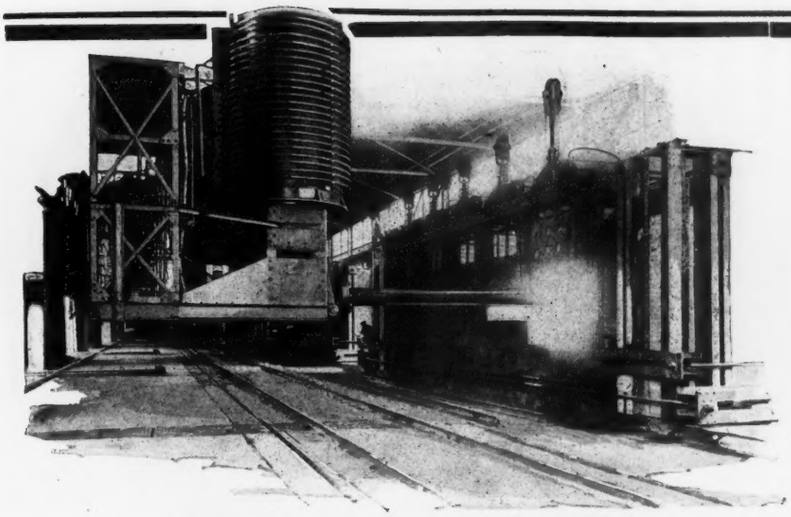


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Acklin engineers are stamping experts, Acklin equipment the most practical they can design or buy, Acklin methods the most efficient they can devise; that is why Acklin's Stampings are well finished and accurate parts are produced at a lower cost than is possible by other methods.

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From bloom to finished product, the manufacture of "SHELBY" Seamless Steel Tubing is a story of continual effort to produce a material that represents the highest standards of a seamless tube.

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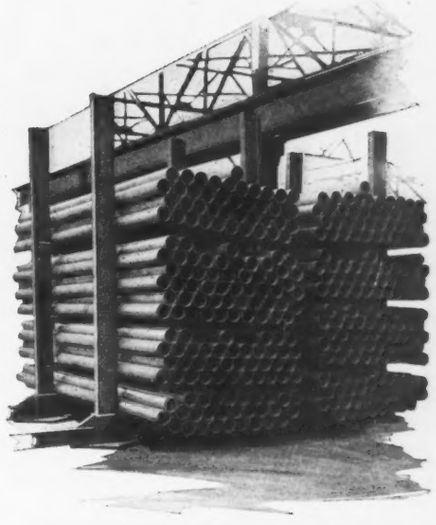
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High Speed Steel

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FREE OF CHARGE

A round piece of equal area if you wish. You have nothing to risk—much to gain.

DO IT TODAY

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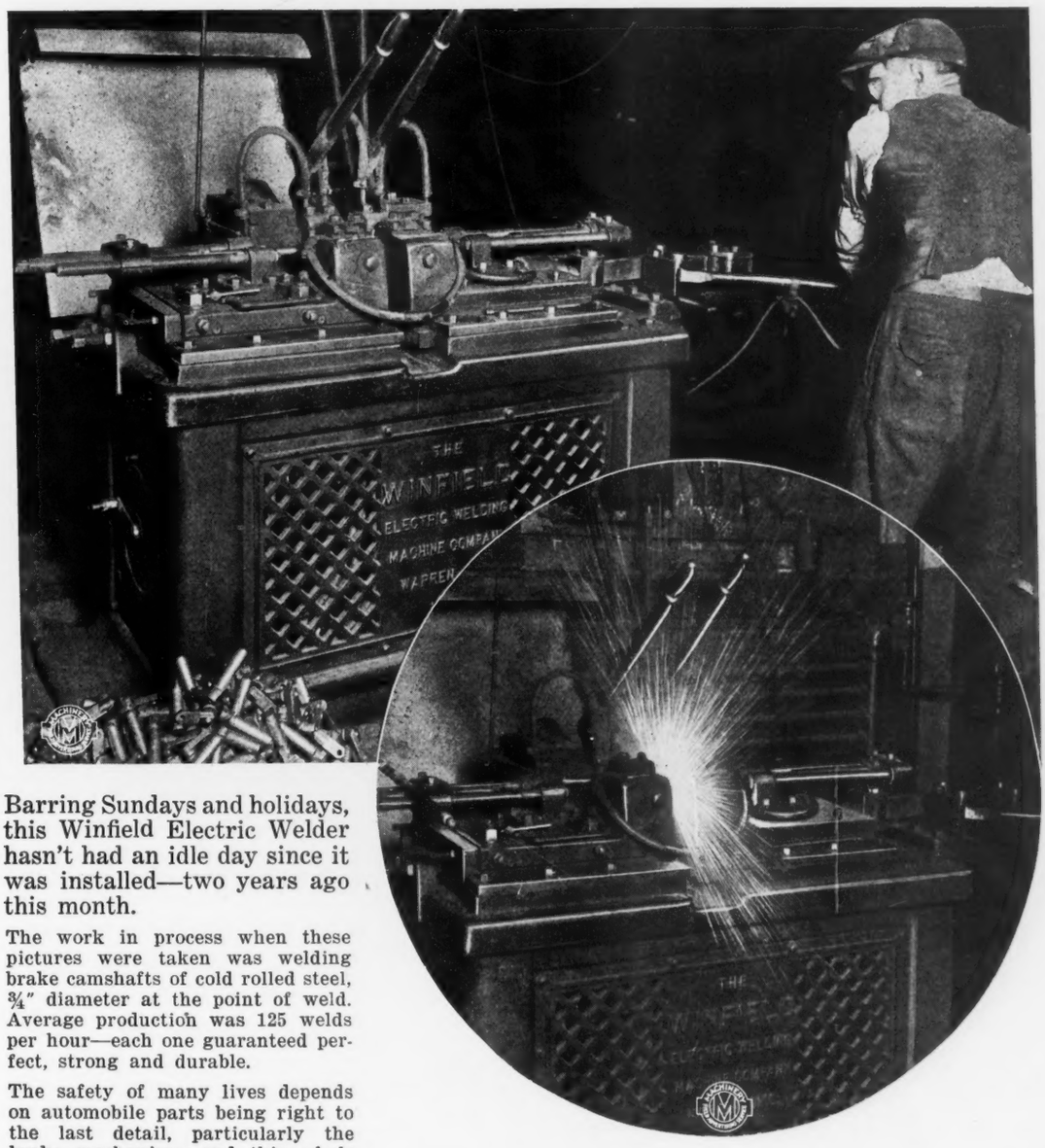
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THE ELECTRIC WELDING CO.

2114-16 SUPERIOR VIADUCT **CLEVELAND, OHIO**

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At the "Timken-Detroit" No. 3 Plant



Barring Sundays and holidays, this Winfield Electric Welder hasn't had an idle day since it was installed—two years ago this month.

The work in process when these pictures were taken was welding brake camshafts of cold rolled steel, ¾" diameter at the point of weld. Average production was 125 welds per hour—each one guaranteed perfect, strong and durable.

The safety of many lives depends on automobile parts being right to the last detail, particularly the brake mechanism, and this whole organization is so imbued with its responsibility in this respect that every man and machine is keyed to attain as close to perfection as possible—every machine in the plant being selected because of its peculiar fitness for its work.

We shall be glad to tell you more about Winfield Welding and to estimate from samples or blue prints of *your* work.



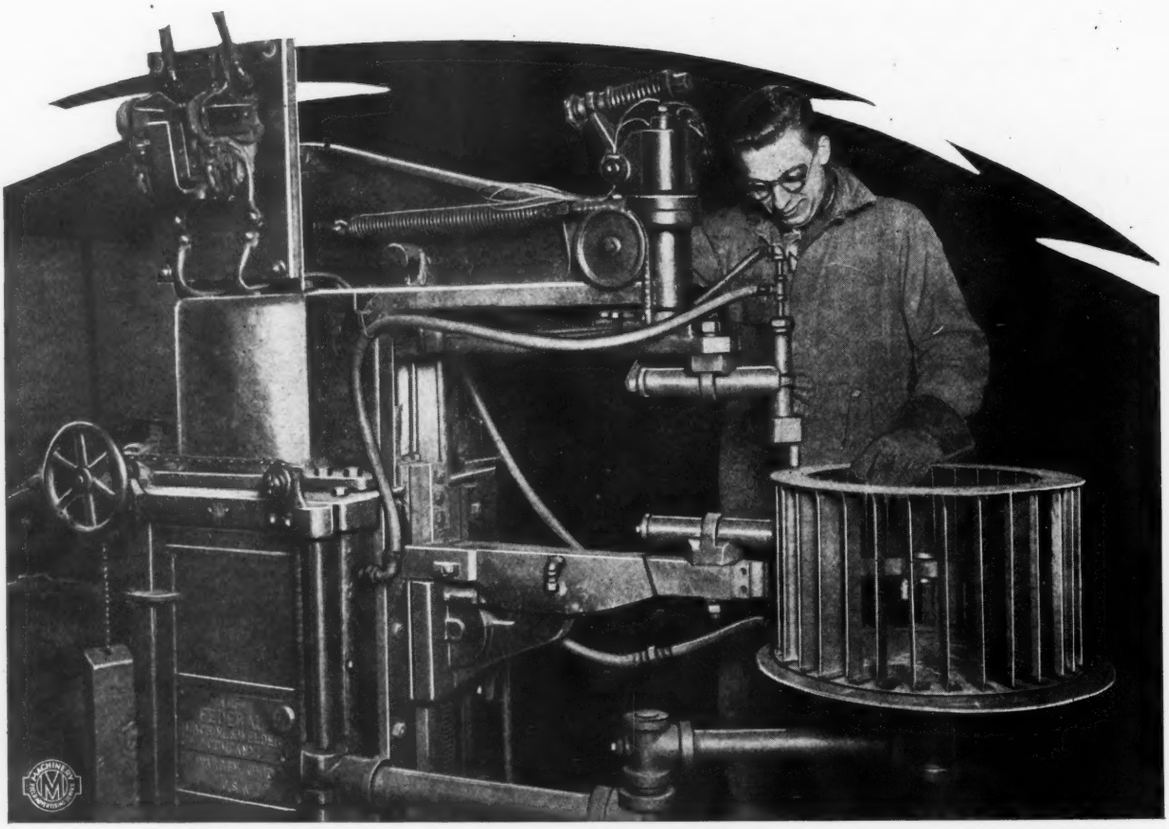
The Winfield Electric Welding Machine Co.

Factory and General Office:

WARREN OHIO, U. S. A.

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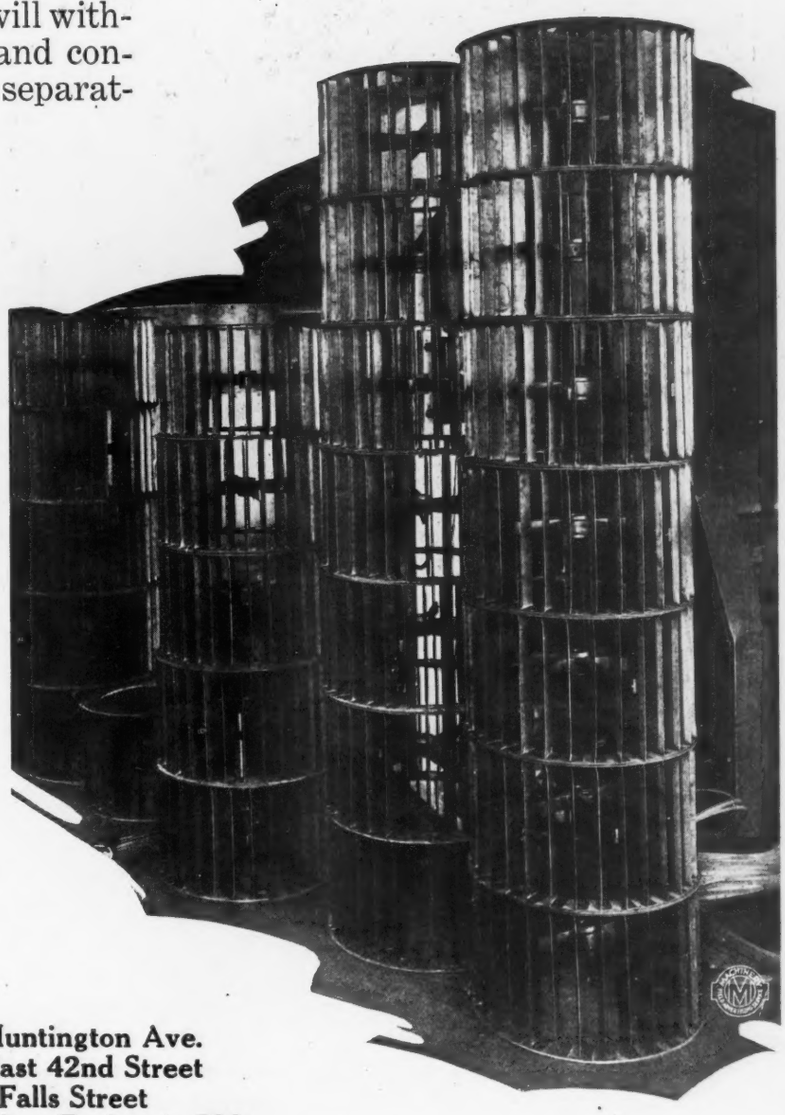
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Correctly welded joints—strong as the original metal—will withstand pressure, shock and constant jarring without separating.

Federal Spot and Butt Welders are made in several sizes for all classes of work. They are *sold outright only*—we have no royalty proposition to offer. Let us tell you about them.

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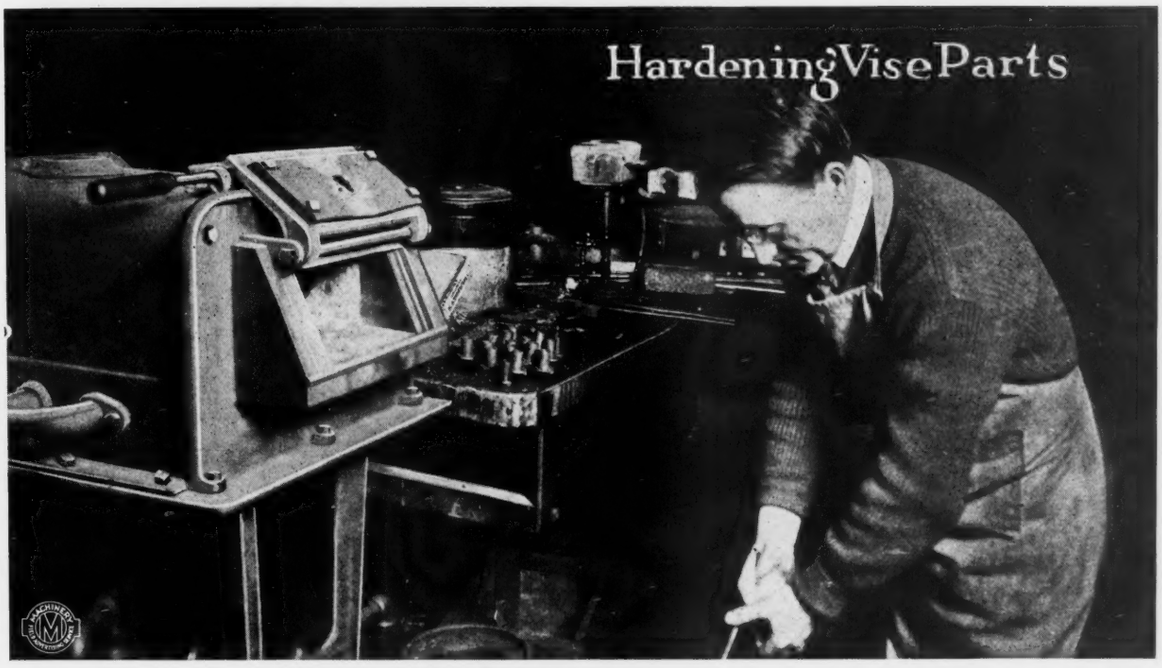


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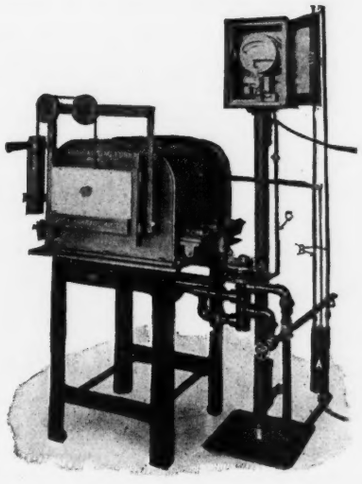
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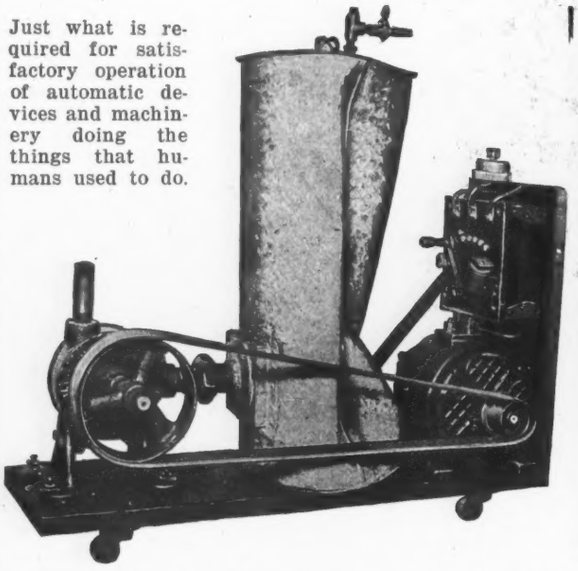
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This shows that the suction is there—it shows that even the small machines can do powerful work. Then there are NINE SIZES.

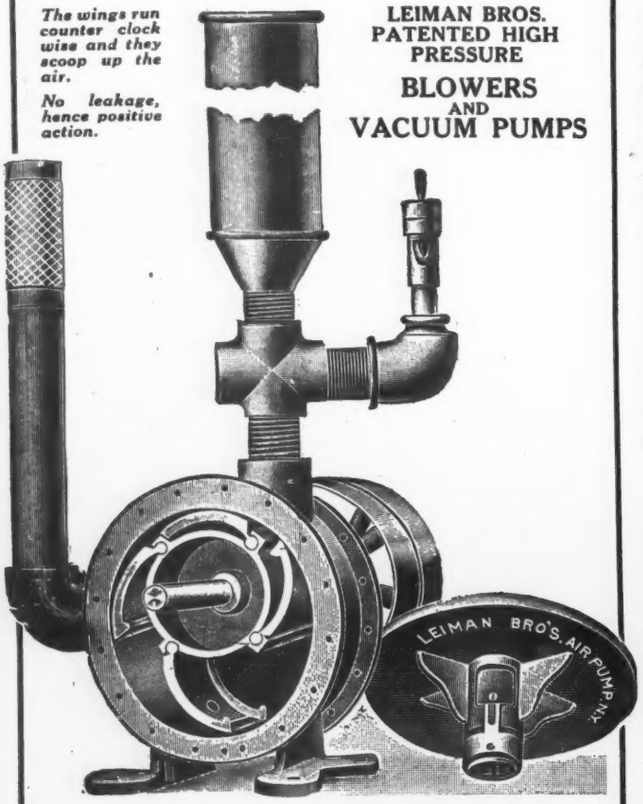
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The wings run counter clock wise and they scoop up the air.

No leakage, hence positive action.

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BLOWERS AND VACUUM PUMPS



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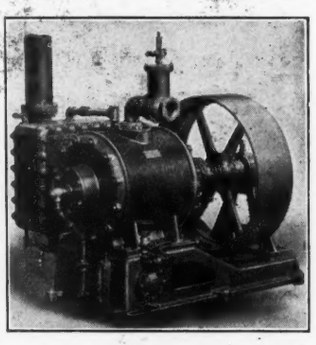
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Ask for the Circulars

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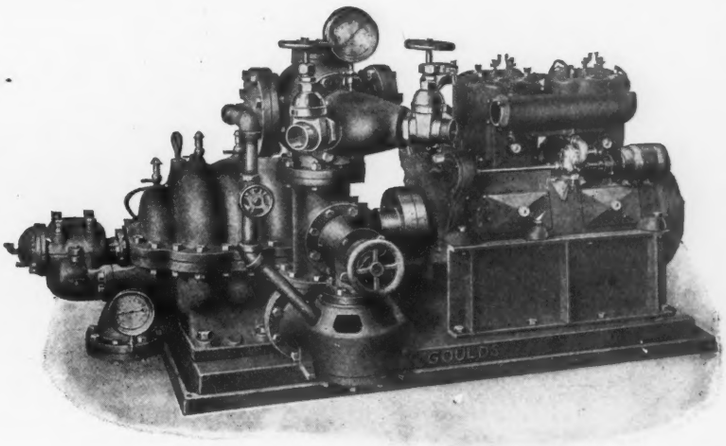
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Those outfits can also be furnished without the underwriters' fittings for general pumping service. They can be furnished with or without electric self-starters, as desired.



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have this advantage—the flow of coolant can be cut down or shut off entirely, without damage to the pump or pipe and without the aid of a relief valve. Many other points of advantage are detailed in our booklet "Full Facts."

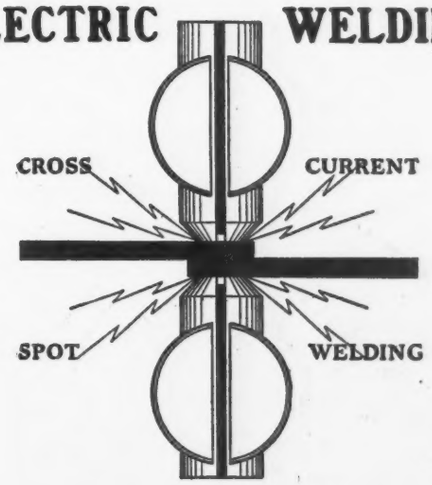
THE VOLYUM PUMP COMPANY
2025 Elm Street CINCINNATI, OHIO

"FULFLO"

—the brief way to specify *the* Trouble-proof Lubricant Pump. Thousands have been convinced by test. Let us show you. Easily attached to any machine in your shop.

The Fulflo Pump Co., Blanchester, O., U.S.A.

TAYLOR ELECTRIC WELDING



The advantages of the Taylor method of spot welding, which provides a greater concentration of heat at the point of contact, not only reduce welding time, current consumption and wear on the electrode points, but also permit welding heavier material. Production records tell the story.

Ask for them when you write for the catalog.

THE TAYLOR-WELDER COMPANY
WARREN OHIO, U. S. A.

Thomson Process
Electric Welding

THOMSON Spot Welders

The Choice of Production Engineers

Ask for Bulletin or outline your assembling problems.

A Thomson Spot Welder in your assembling department soon pays for itself by the time and trouble it saves. It eliminates the use of rivets and the necessity of punching and drilling, makes a neat, *permanent* joint and its output is limited only by the dexterity of the operator, who need not be a skilled mechanic.

Thomson Spot Welding has a wide range of application—the lamp shade frames here shown being one of the simpler assembling operations on which this practical, economical process materially reduces the cost.

Thomson Spot Welder Company

LYNN, MASSACHUSETTS, U. S. A.

BUFFALO.....595 Ellicott Square Building
CHICAGO.....817 W. Washington Blvd
CINCINNATI...Knowlton & Langland Streets
DETROIT.....English & Miller Mchy. Co.
DULUTH.....Northern Machinery Company

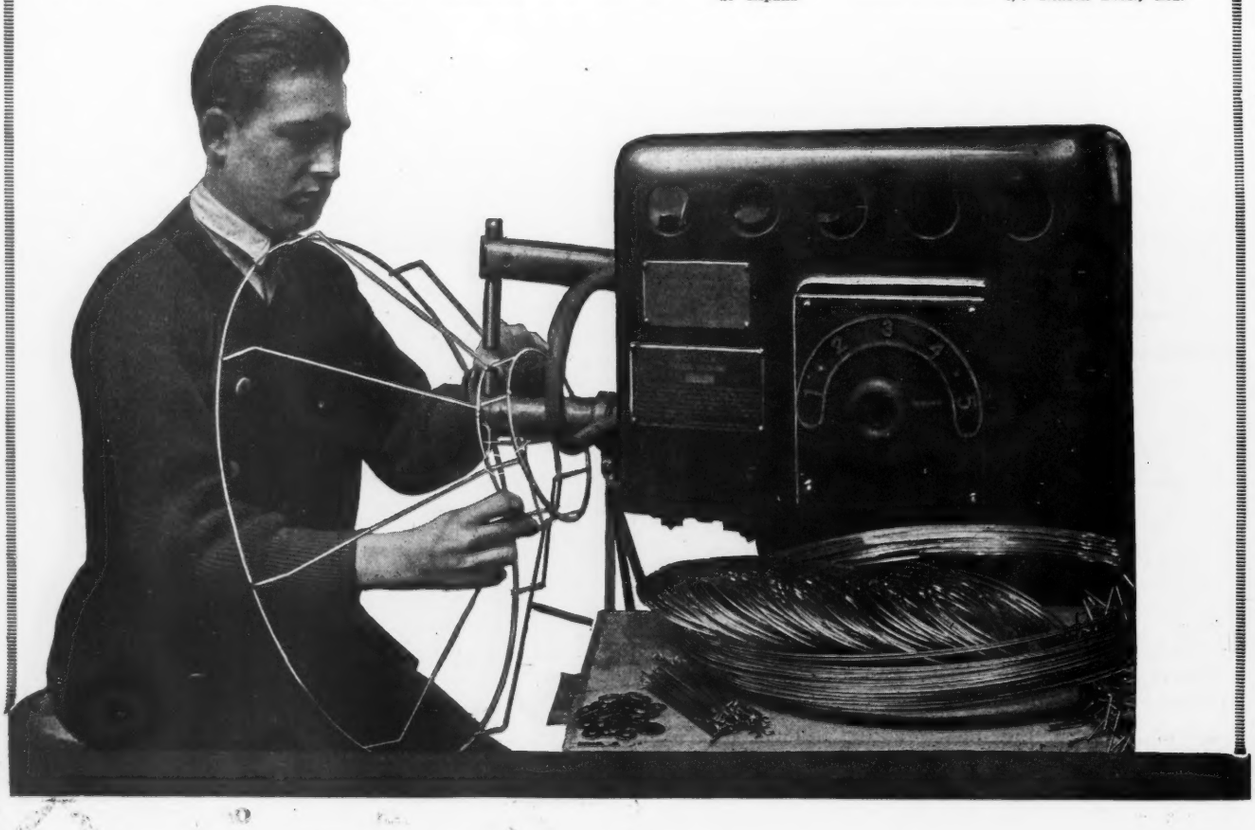
GRAND RAPIDS....McMullen Machinery Co.
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Thomson Process
Electric Welding

The Reputation of Thomson Butt Welding Is Based on 30 Years of Satisfactory Performances

Thomson Butt Welders are substantially built, hard service machines with capacity for 25 to 800 welds per hour according to size of stock, machine, etc., and have a reputation earned by achievement.

Many "Thomson" machines have been 20 to 25 years in daily operation and are still going strong—what's more, the welds they have made during this time are still *holding strong.*

Tell us your welding problems and ask for the corresponding bulletin.

Thomson Electric Welding Company

LYNN, MASS., U. S. A.

BUFFALO.....595 Ellicott Square Building
CHICAGO.....817 W. Washington Blvd.
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DETROIT.....English & Miller Mchy. Co.
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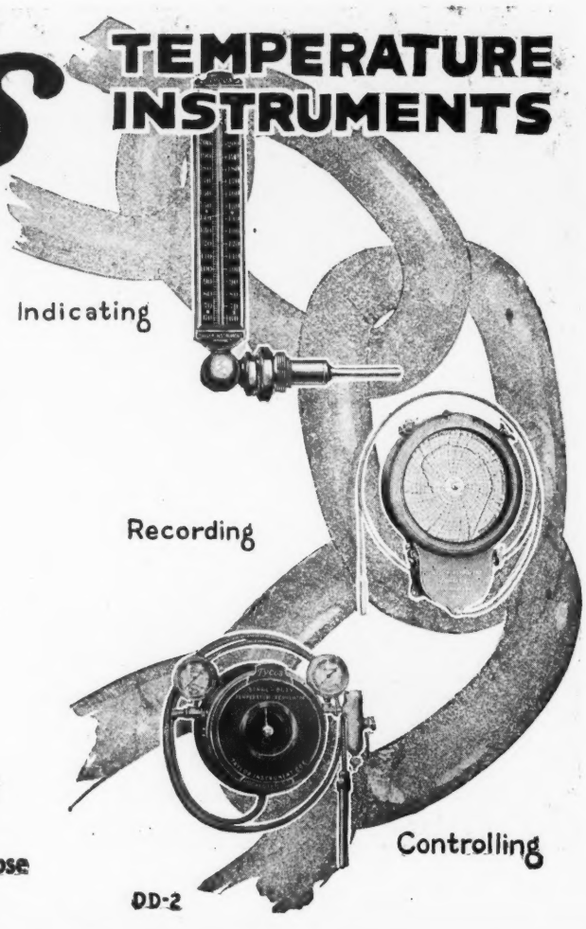
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The Basic Factors of Industrial Control

IN practically all the process work of modern industry *Tycos* Indicating, Recording and Controlling Temperature Instruments are standard today.

A lifetime devoted to the solution of special temperature problems has resulted in the development of these instruments to a point of dependability and precision which has not been surpassed.

A request for information on Tycos Instruments will bring you complete data without obligation.



Taylor Instrument Companies
ROCHESTER N.Y.
There's a *Tycos* or *Taylor* Thermometer for Every Purpose

FERRO CASE

Compounds

For Economical Case Hardening

FERRO CASE M for use in Cyanide Melting Furnaces — **Non-poisonous and do not deteriorate.**

FERRO CASE S for Sprinkling on Hot Steel — **Give a clean, hard case at minimum cost.**

Ask us about Ferro Case Compounds
TRY THEM!

C. G. BUCHANAN CHEMICAL CO.
Sta. H, Cincinnati, Ohio, U. S. A.

Scientifically Designed *Substantially Constructed*
One-Valve Control

Gas — INDUSTRIAL FURNACES — Oil

Uniform Temperature *Maximum Output*
Minimum Fuel Cost

These and many other features are what Surface Combustion Furnaces offer. Advise us as to your requirements and we will submit specifications and prices.

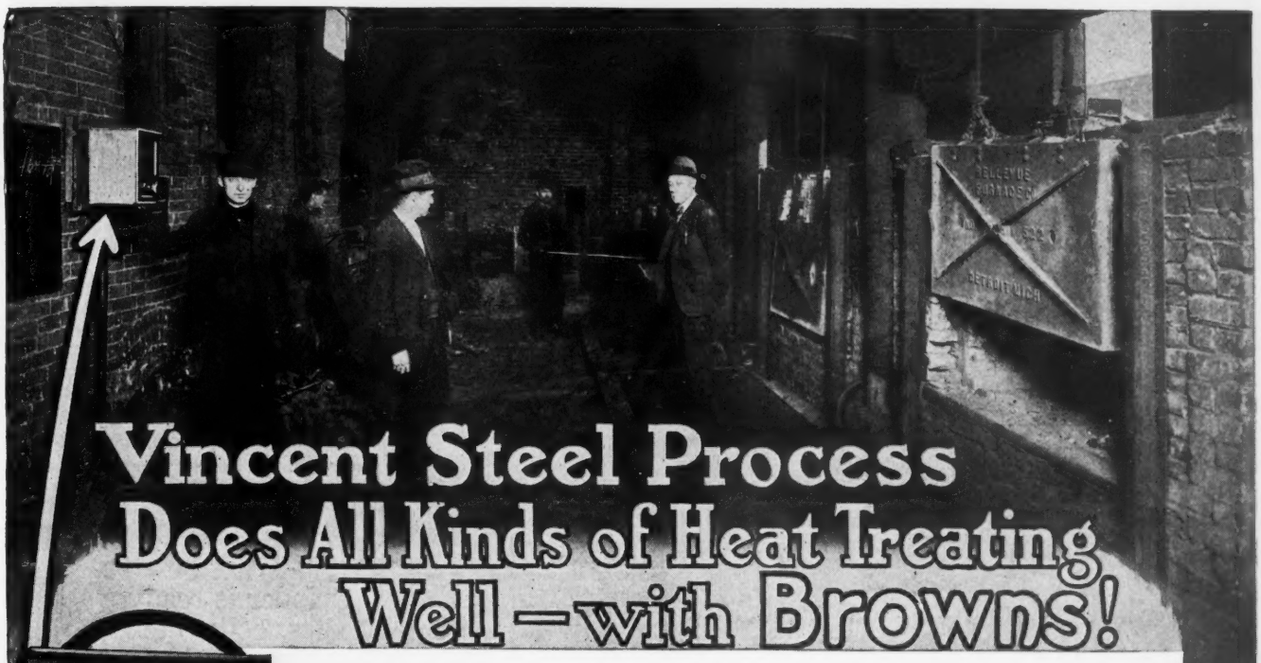
THE SURFACE COMBUSTION CO.
Industrial Furnace Engineers and Manufacturers
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WILSON-MAEULEN CO.

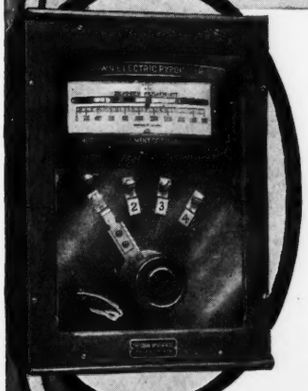
PYROMETERS
Multi Recording
Indicating



736 E 143 St. New York



Vincent Steel Process Does All Kinds of Heat Treating Well—with Browns!

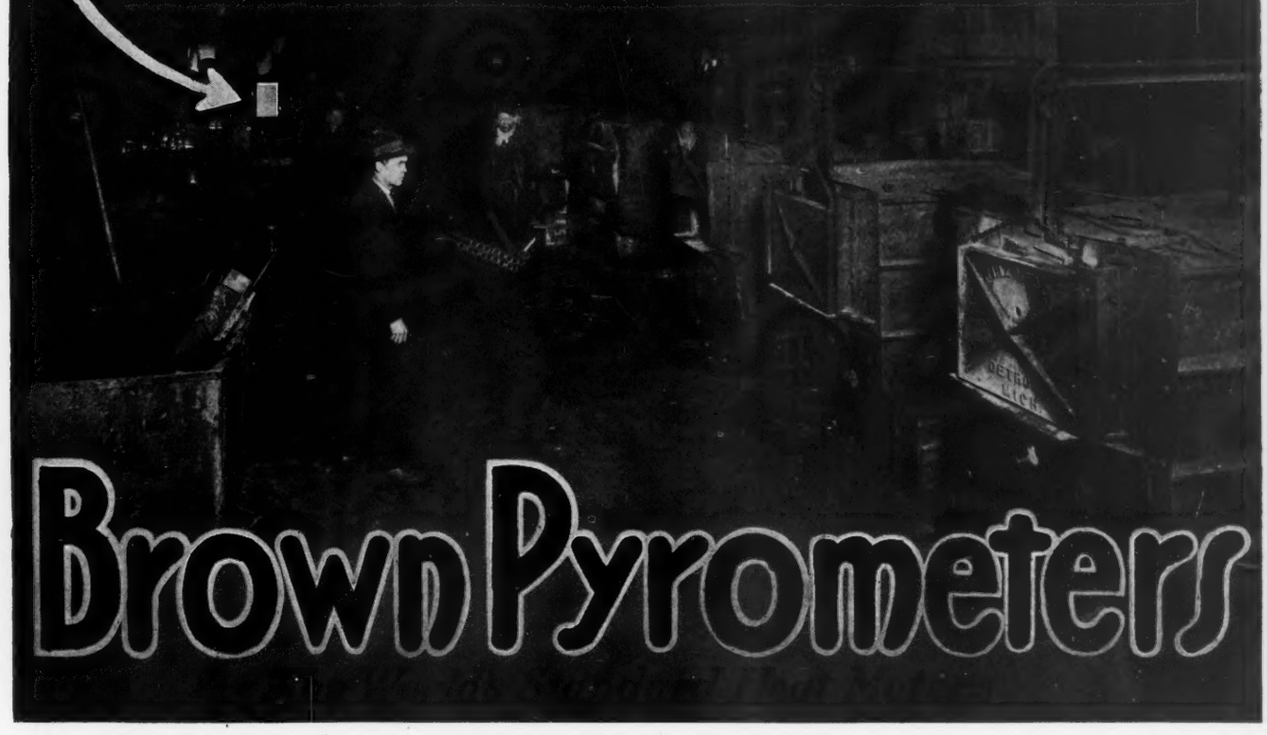


HIGH-SPEED steel hardening, carbonizing, annealing and the cyanide process—all come within the regular work of this twenty-seven-year-young Detroit plant. And they do each so well, that night and day their forty furnaces—ranging from 24 feet and smaller—are kept busy turning out vital parts and fine tools for many of the country's highest priced motor cars.

Notwithstanding their twenty-four years' successful experience—or rather, because of it—the Vincent Steel Process Co. three years ago turned to Brown Pyrometers as the better way of knowing temperatures, both in their metallurgical laboratory and at their furnaces. Their judgment has been fully justified by results, and they frankly admit that their Brown Pyrometer Equipment is a big profit-payer, whether figured on a basis of time, labor or material saved.

This installation and 20,000 others point to a Brown Pyrometer Control as the way out of your heat-treating troubles. Write today for a quotation on an equipment to meet your needs. Address The Brown Instrument Co., Philadelphia, or one of our District Offices in New York, Pittsburgh, Detroit, Chicago, Denver, San Francisco, Los Angeles or Montreal.

The Brown High Resistance Indicating Pyrometer with Switchboard

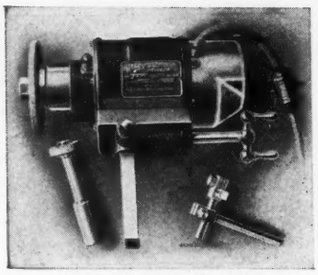


Brown Pyrometers

How to Grind Dies Without an Internal Grinder

Put a Hisey Portable Electric Grinder on that lathe and presto!—your lathe is all ready for internal grinding, and will give most accurate and satisfactory results.

With a Hisey Grinder you are equipped to do the greatest variety of work without installing a lot of expensive machines which take up floor space and boost your overhead.



Lathe Center Grinder
Made in ¼ H. P. and ½ H. P. sizes

Use a Hisey Portable Electric Grinder

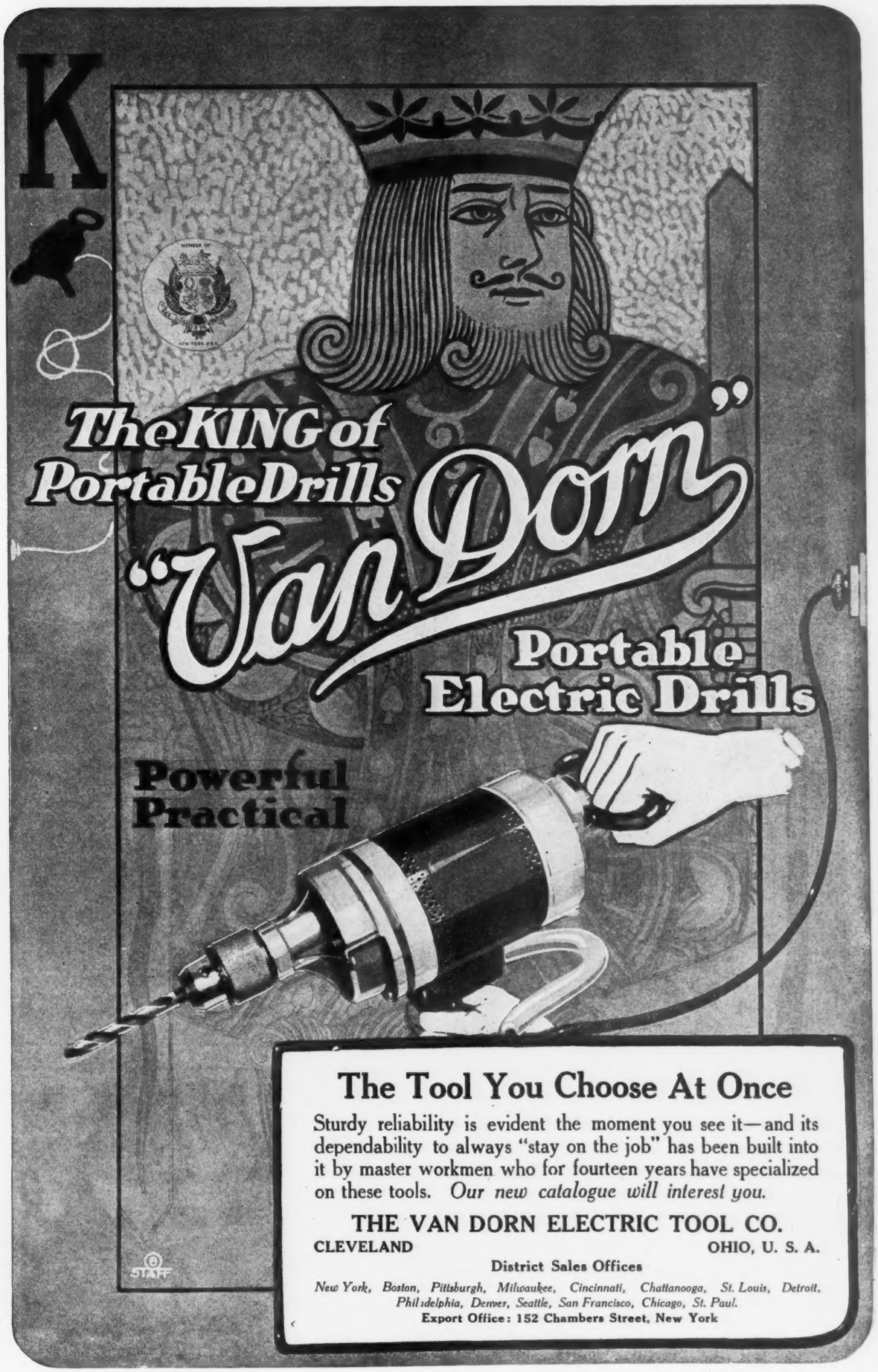
This Hisey Portable Electric Grinder is ready to grind your lathe centers, dies, rolls, etc., and the holes of collars, dies and jig bushings, or for sharpening reamers, milling cutters, gear cutters and tools. The Hisey will earn its cost in the money it saves.

The photograph shows the Hisey Portable grinding a die for motor laminations.

Send for Bulletin No. 1102-M.

The Hisey-Wolf Machine Co.
Cincinnati *Agencies in All Principal Cities* **Ohio**





The Tool You Choose At Once

Sturdy reliability is evident the moment you see it—and its dependability to always "stay on the job" has been built into it by master workmen who for fourteen years have specialized on these tools. *Our new catalogue will interest you.*

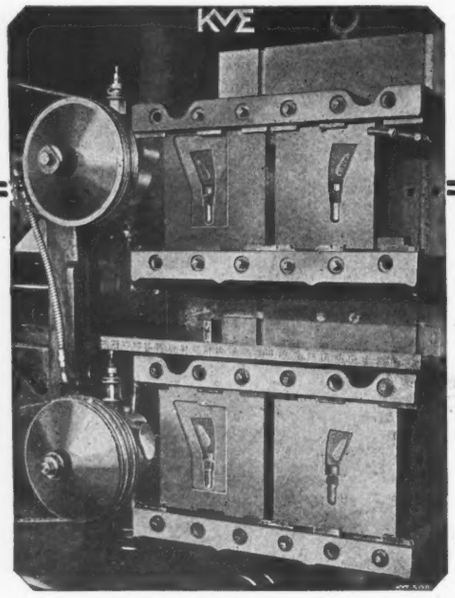
THE VAN DORN ELECTRIC TOOL CO.

CLEVELAND **OHIO, U. S. A.**

District Sales Offices

New York, Boston, Pittsburgh, Milwaukee, Cincinnati, Chattanooga, St. Louis, Detroit, Philadelphia, Denver, Seattle, San Francisco, Chicago, St. Paul.

Export Office: 152 Chambers Street, New York



Thresher tooth dies being cut automatically on the Keller Machine.

"It beats me!

I've combed the whole city, and I've advertised, and can't find another die sinker. How do you manage to keep up your production?"

"Why, I was up against the same thing: couldn't get dies or die sinkers, and I had to turn down some big orders. Then one day I happened to be going through the Blank Plant, and noticed some machines turning out dies automatically; they were Keller Automatic Die-sinking Machines. I wrote the Keller people for information and as a result, installed two of their machines: now I have two more on order."

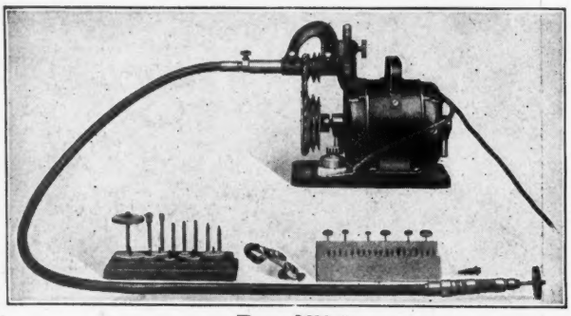
"Keller Automatic Die Sinkers? Why, I saw one some years ago and didn't think so much of it. Doesn't it require a lot of skill to operate and leave a good deal of hand work to be done on the dies?"

"No indeed! I remember that old type, but the Keller Machine of to-day is a different proposition. The beauty of it is that the average mechanic can keep as many as three going and they operate entirely mechanically, beyond a little preliminary roughing they turn out beautifully matched dies. I advise you to write Keller."

That's Good Advice.

Keller Mechanical Engraving Co.
74 Washington St. Brooklyn, N. Y.
KME-11

HASKINS



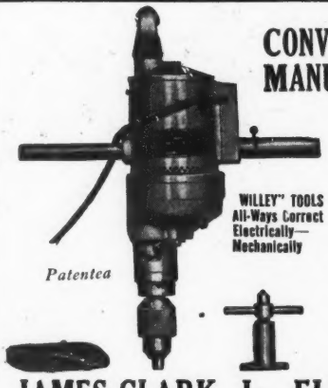
Type MH-4

DIE SINKING EQUIPMENTS

are especially designed to promote production and reduce costs in your plant.

Write today for complete details regarding this and other HASKINS LABOR SAVING EQUIPMENTS.

R. G. HASKINS COMPANY
Manufacturers and Distributors of Portable Machinery
27 SO. DESPLAINES ST. CHICAGO, ILL.



CONVENIENT TOOLS CUT MANUFACTURING COSTS

"WILLEY'
Portable Electric Tools

Can be used anywhere, take their power from the nearest light socket. Convenient, adaptable, fool proof.

Catalog?
Jacobs Chucks used as regular equipment

JAMES CLARK, Jr., ELECTRIC CO., Inc.
522 W. MAIN STREET LOUISVILLE, KENTUCKY.

TOOL POST GRINDER

Hand Feed and Plain

For grinding Centers, Dies, Cutters, etc.

Does both Internal and Surface Grinding.

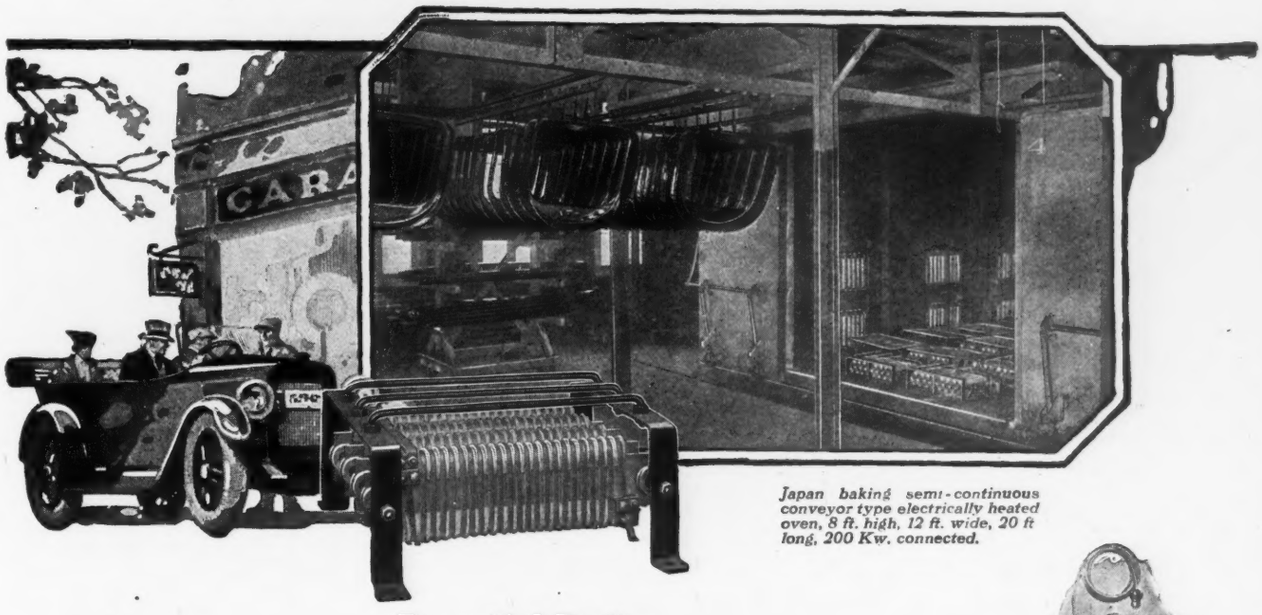
Supplied with ⅜ x 6" wheel internal grinding attachment.

Ten-foot flexible cord and plug to fit any standard lamp socket.



STOW MFG. CO.
BINGHAMTON, N. Y. U. S. A.
London Stock: 85 Queen Victoria St.

Five years ago electric heat was somewhat of a novelty—today it is doing what was then considered impossible with any kind of heat



Japan baking semi-continuous conveyor type electrically heated oven, 8 ft. high, 12 ft. wide, 20 ft long, 200 Kw. connected.



Compound melting pot



Electric soldering iron



Electrically heated glue pot

Beautiful Bodies Help Sell Motor Cars

ANY motor car builder will admit that a large number of cars is sold on "looks." As a result, the finishing of bodies and all enameled parts, such as fenders, wheels, tanks, etc., is a process that requires most careful consideration and the best equipment available.

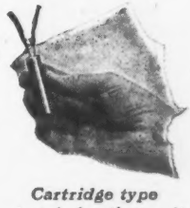
In this process, the electric oven has come to the front through its obvious advantages over old-fashioned methods of baking. Its use greatly increases production thereby reducing the unit cost, even with higher rates for power than for fuel. Electric heat produces a lustrous, hard finish so essential for lasting beauty, and it requires less time than other forms of heat, with more accurate control, greater safety, and practically no defective work that must be done a second time.

The flexibility of electric heat is remarkable since it permits the use of varying degrees of heat in different parts of the same oven or furnace. For this reason, electric heat is rapidly being applied to the baking of varnish, enamel, japan, and other finishes; to the melting of metals and alloys; to the heating of steel so that it may be chemically treated; to the drying of salts, sand cores, pottery and grinding wheels; to the heating of rivets, soldering irons, etc.; and even to the sherardizing of steel to make it rust-proof by depositing on its surface a coating of zinc about twenty-five ten-thousandths of an inch thick.

To every one of the many uses of electric heat the General Electric Company has contributed in a broad way, until today the mark G-E on any electric heating device is the mark of the master. Thus it is to any manufacturer's advantage to consult G-E engineers before selecting such equipment.



Pyrotip lead burner



Cartridge type electric heating unit



Soldering iron muffle furnace

General Electric Company

General Office Schenectady, N.Y.

Sales Offices in all large cities

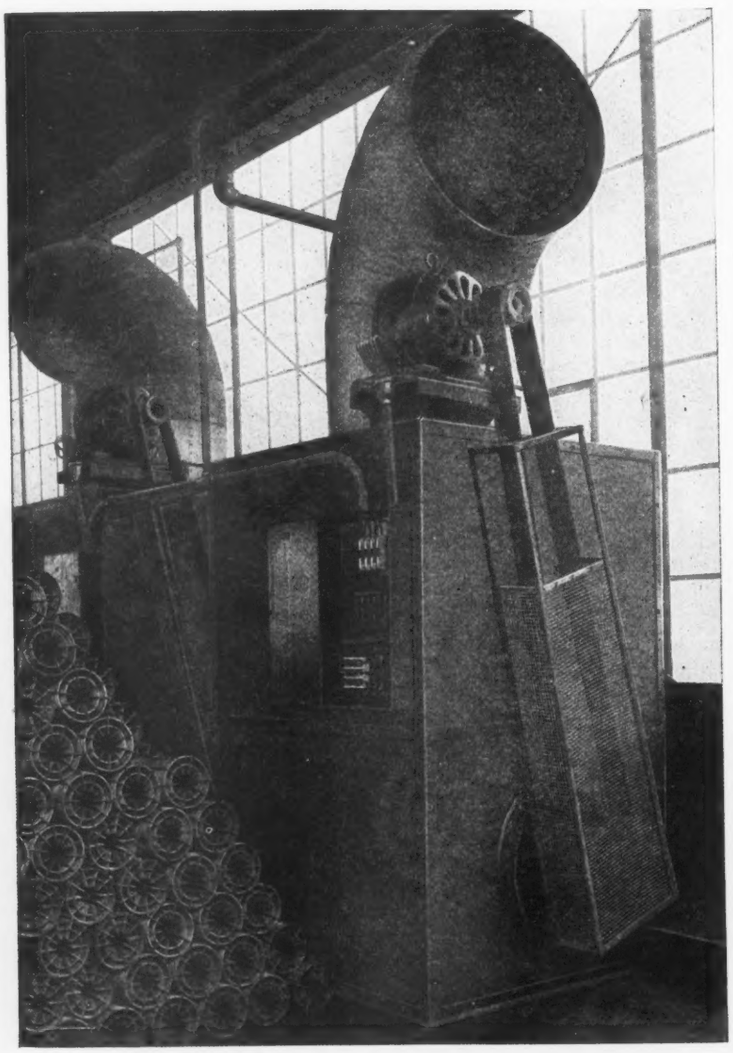
39-40

Put this thought before all others

in buying motors, and assure yourself of continuous, dependable power.



Quality, not first cost should decide



Two fifteen horsepower Wagner Motors, driving air heaters in foundry

You are not buying motors to discard them in a week or a month. The cost of a motor is the final checking up of first cost plus repairs and interrupted production.

Insure your power. It's the Quality that protects you and the preference you pay is the premium. Send for Bulletins 11824 and 12224

Wagner Electric

Manufacturing Company, St. Louis, Mo.

510

The Pioneer Non-sparking Motor

Some 40 years ago E-D engineers announced to the world the first successful non-sparking direct current motor—the E-D Inter-pole. Since that time it has been widely imitated.

But E-D set the pace, and we are confident that the E-D Inter-pole Motor of today, embodying the developments and refinements of the ensuing years, is representative of the highest attainment in sparkless commutation.

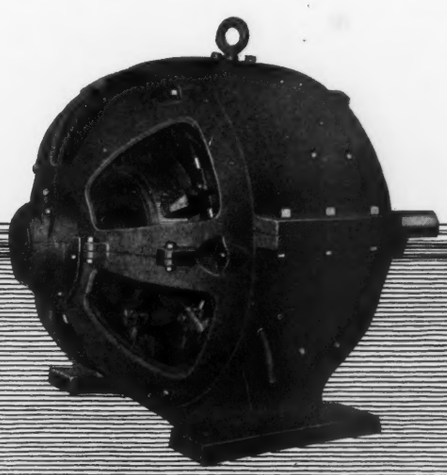
Get acquainted with the entire line of E-D Motors and Generators—A.C. ¼- to 200-hp. D.C. ½- to 300-hp. It has a time-tested record for dependable service. Write for Catalogs.

Electro Dynamic Company, Bayonne, N. J.

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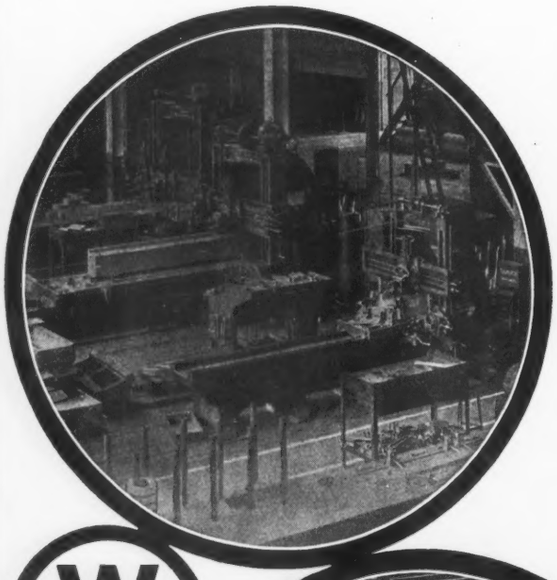


Electro Dynamic Motors

Westinghouse

SPECIALISTS IN THE DESIGN AND APPLICATION OF

Machine Tool Motors and Control



Meeting Requirements With Past Experience—

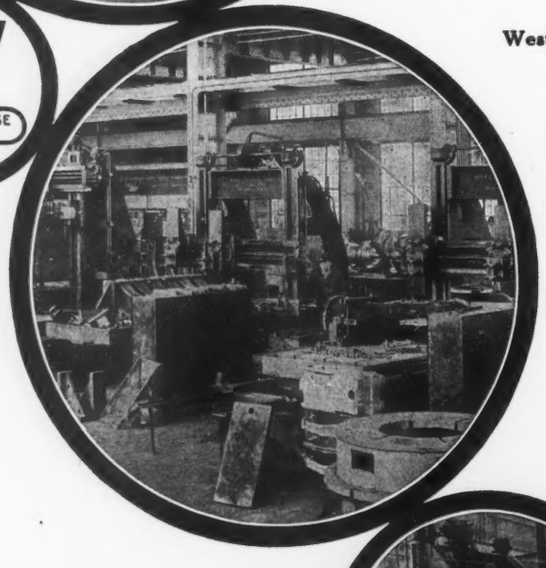
The experience of Westinghouse Engineers in equipping machine tools with motor drive and control has been broad and varied. It is represented by thousands of horsepower of motors and control installed in various machine shops throughout the country.

The capitalization of this experience prevents guess work, and assures the procurement of equipment that meets every requirement.

Westinghouse experience covers the entire range of machine tool application, and covers it THOROUGHLY.

Westinghouse Electric and Manufacturing Co.
East Pittsburgh, Pa.

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WESTINGHOUSE ELECTRIC



Sales Offices in all large American Cities

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Planer Applications.

ANNOUNCING

Hurlbut-Rogers Broaches

We're making broaches! All kinds of broaches! For all purposes!

We've equipped a plant in Hudson, Mass.; purchased new machines and tools; associated with us skilled and experienced men; and we're booking orders right now for early delivery.

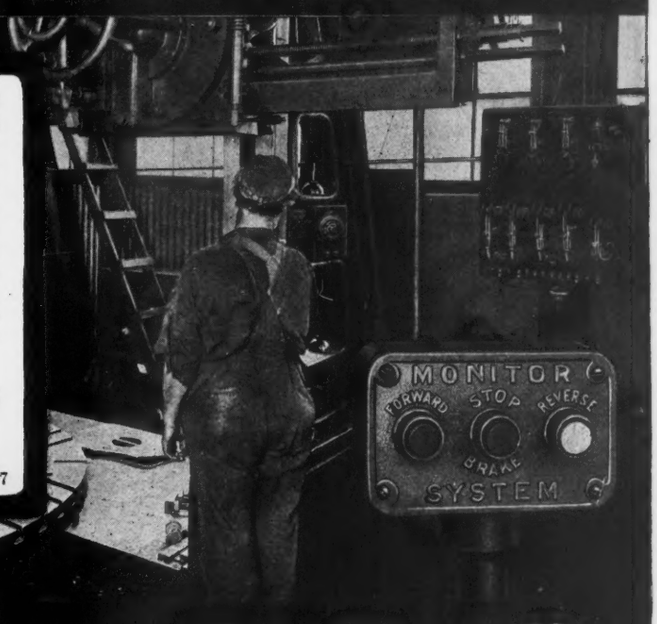
This Hudson shop is entirely distinct from and independent of our South Sudbury plant—the only thing in common being the capital behind both businesses and the four-square policy under which both will be run. Permit us to work with you—we'll make it pay you.

The Hurlbut, Rogers Machinery Co.

SOUTH SUDBURY, MASS., U. S. A.

SELLING AGENTS: E. A. Harper Tool & Supply Co., New York (for New York, Boston, Philadelphia, Baltimore); Cleveland Duplex Machinery Co., Cleveland, Ohio; J. R. Stone Tool & Supply Co., Detroit, Mich.; R. E. Ellis Engineering Co., Chicago; A. D. Heath, Indianapolis; John M. Howett, Dayton, Ohio.

The Monitor System



This Monitor-controlled motor-driven boring mill is started, stopped, reversed, or slowed down from one central Monitor push-button Control-station. Note it, directly above the operator's right shoulder. Briefly, while every operation is simplified, maximum production is secured with assurance of safety to man, motor and machine. The operation of every motor-driven boring mill, lathe, grinder, planer in your shop *can be* similarly controlled and safeguarded by The Monitor System. "Just press a button" to start, stop, reverse, accelerate or decelerate. Our Bulletin No. 1006, "Machine Tool Control," completely describes the System.

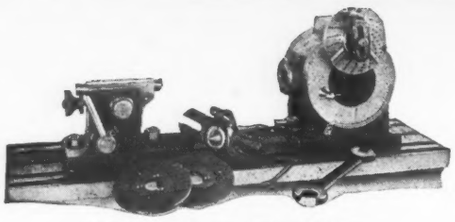
Monitor Controller Company

Baltimore, Md., U. S. A.

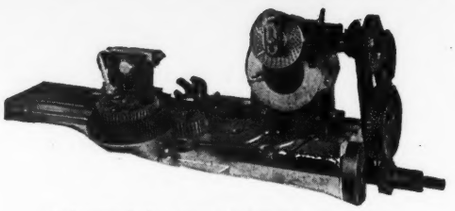
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"Just Press a Button"

SIMMONS
OF ALBANY



Plain Index Centers Swing 10" Diam.

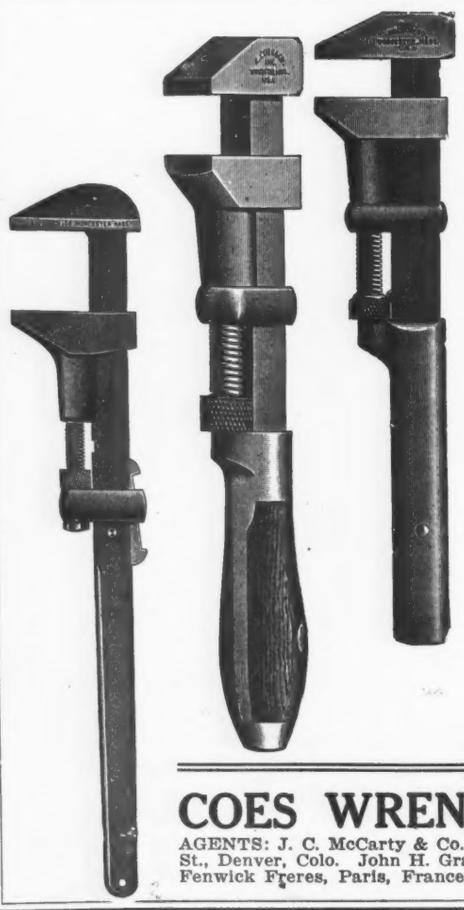


Universal Index Centers with Spiral Cutting Attachments

These Dividing Heads or Index Centers may be used on any milling machine; are well designed; materials are the finest obtainable. The Universal Index with Spiral Cutting Attachment is a quite recent development and will be found remarkably useful in any tool-room. Let us tell you more about these accessories.

SIMMONS MACHINE CO., Inc., ALBANY, N. Y.

BRANCHES: 801 Singer Bldg., New York 358 Ellicott Square, Buffalo, N. Y. Albany and Buffalo Warehouses



"COES" WRENCHES

Honest Tools for Honest Service

A Coes Wrench in your kit sets a standard that pays. Good tools are not "cheap," though they cost least in the long run.

For instance, the care taken in designing and manufacturing Coes Wrenches, and in the selection of the materials put into them, the sixteen inspections (eleven during the course of manufacture—five after completion) that insure their perfection, cost money, *but they pay.*

It is these things that make Coes Wrenches practical, convenient tools that give better service and out-wear most tools of their class.

Sizes, 6" to 72". Write for the catalog of styles and prices, or see them at your dealers.

COES WRENCH CO., Worcester, Mass., U.S.A.

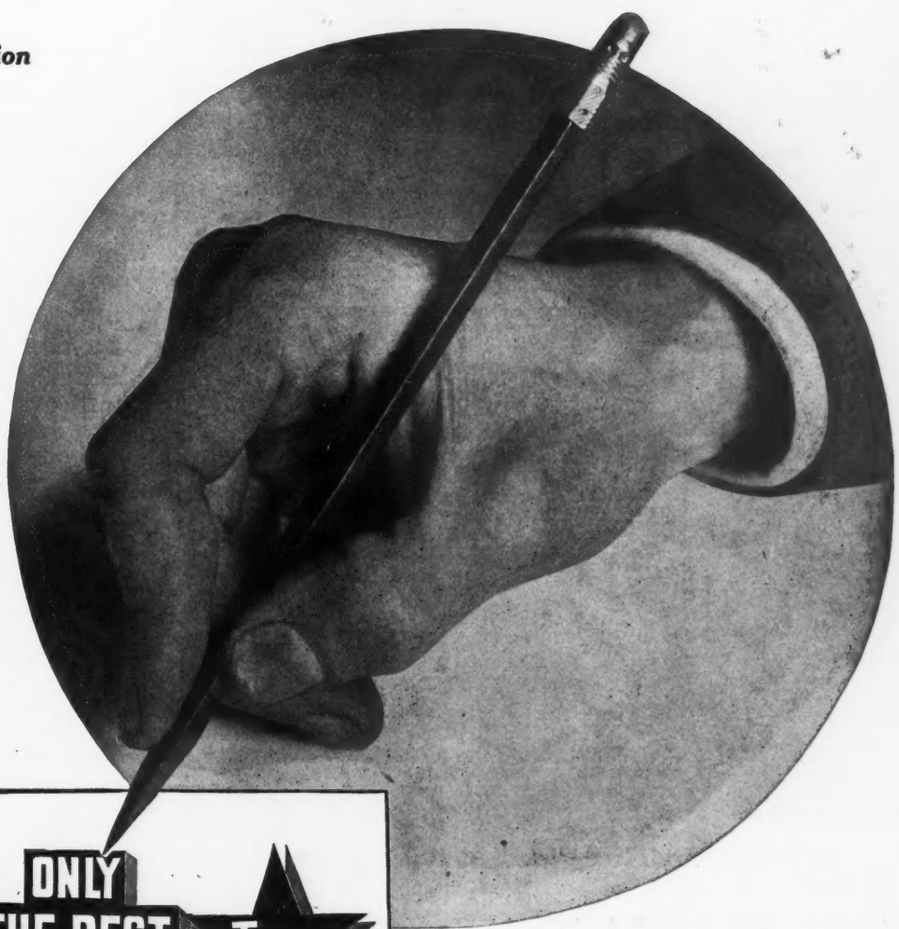
AGENTS: J. C. McCarty & Co., 29 Murray St., New York. 438 Market St., San Francisco, Cal. 1515 Lorimer St., Denver, Colo. John H. Graham & Co., 113 Chambers St., New York. London, E. C., 118-122 Holborn. Fenwick Freres, Paris, France.

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Files of Precision—Toolmakers' Files

Our trade-mark — the Swiss Cross flanked by two American stars—is as much your protection as ours. It guarantees you files that are correct in shape and cut, uniformly hardened and made always of the best material. Files with edges and points well covered and points uniformly sharp. Files which are the choice of America's skilled hand-workers, for whom only the best is good enough, and who invariably specify "American Swiss."

Accurate Duplication Also Guaranteed



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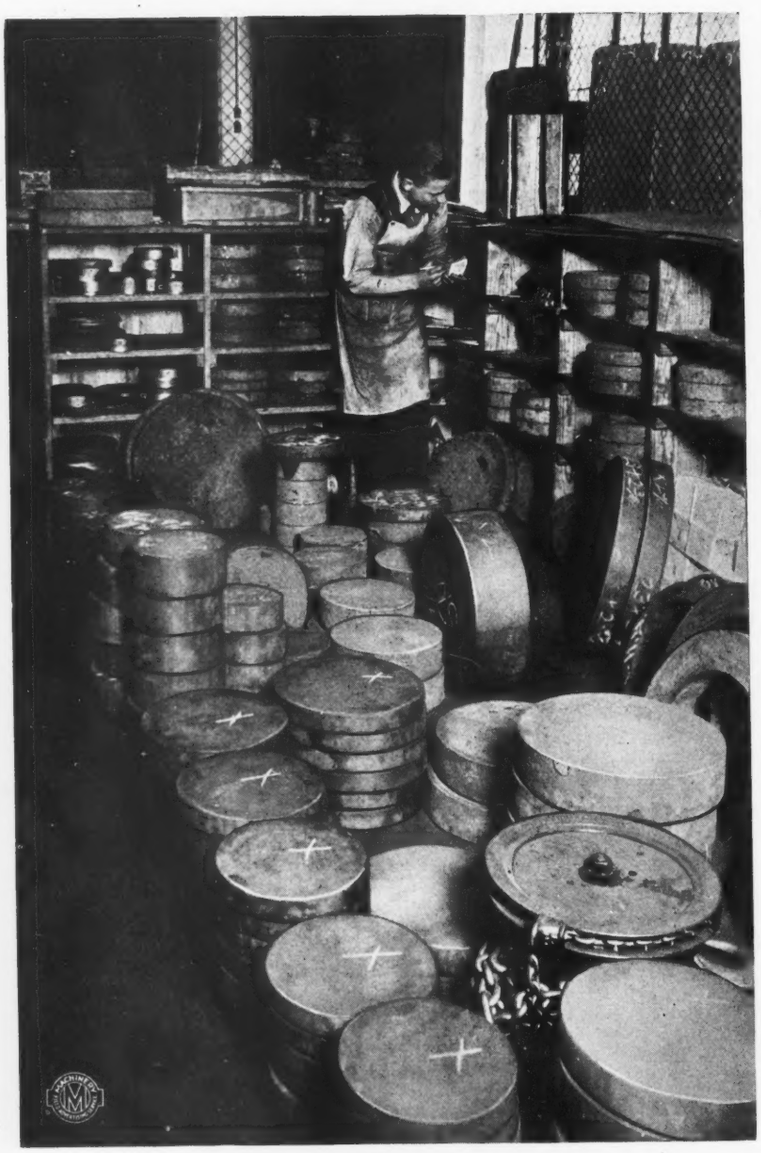
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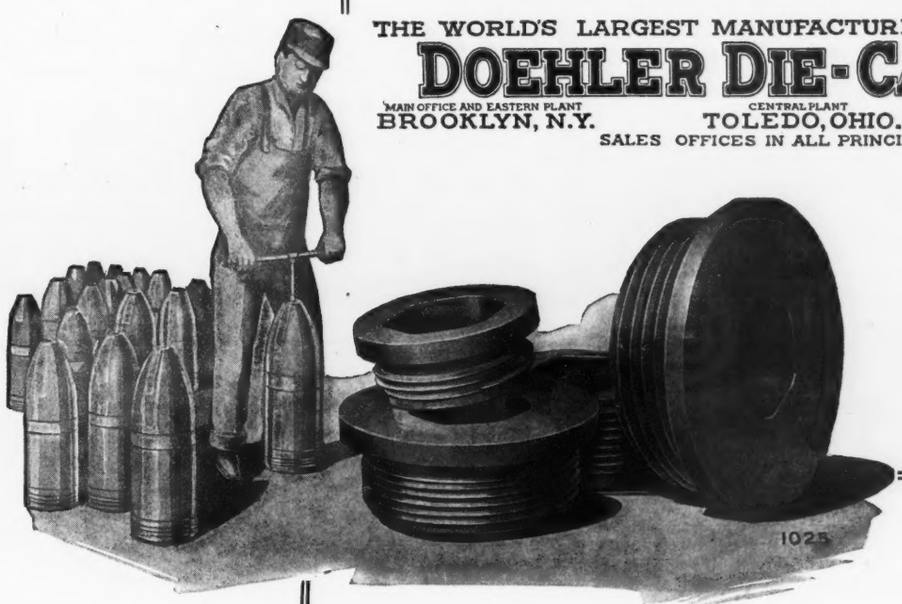
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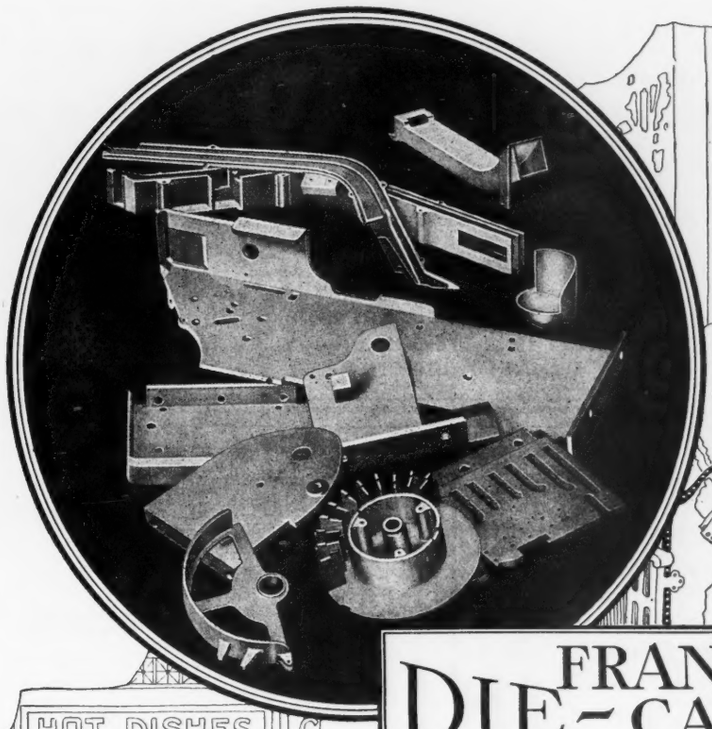
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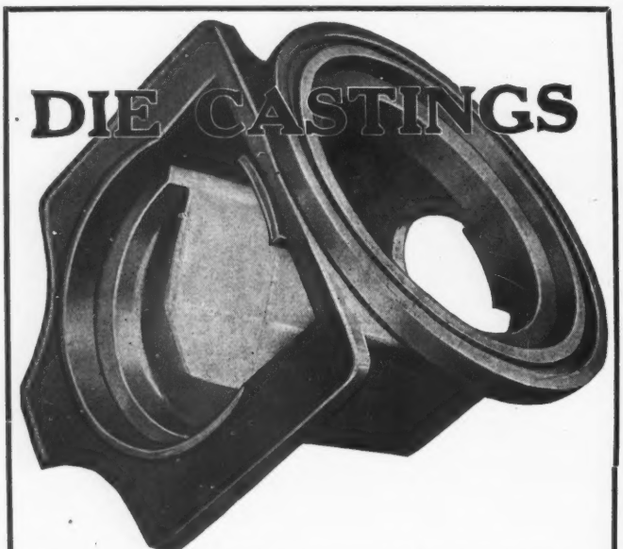
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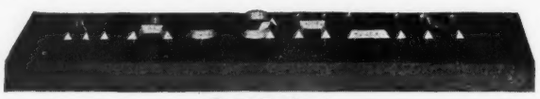


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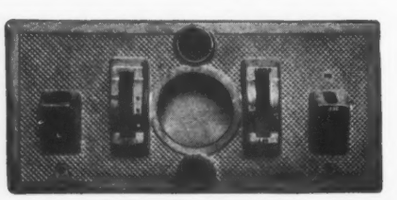
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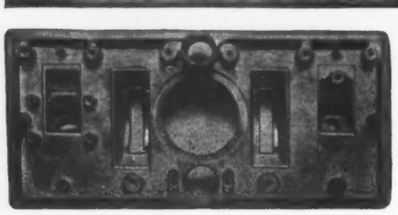
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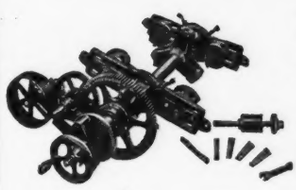


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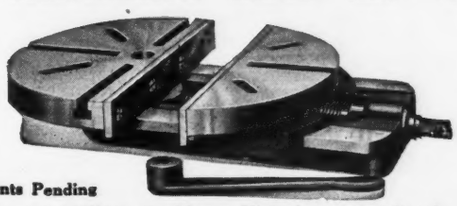


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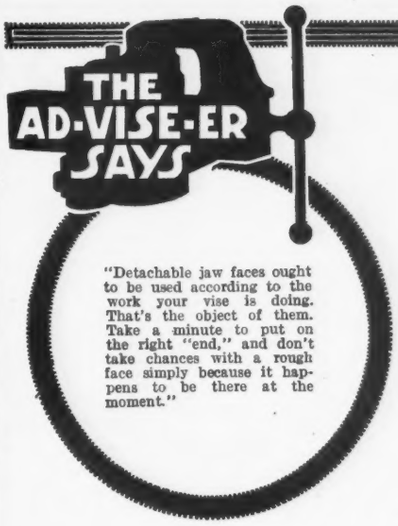


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Fundamentally the object of a vise is to grip and hold.

Some people expect just this from a vise and nothing more.

It is true that some vises do just grip and hold; but the wider adaptability of Prentiss vises is due to innovations and outstanding improvements, such as the self-adjusting jaw, the swivel bottom, interchangeable jaw faces, etc. In the hands of a good workman a Prentiss vise is a tool for fine and efficient work.

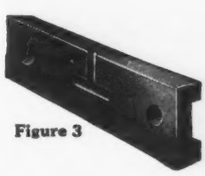


Figure 3

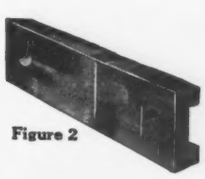


Figure 2



Detachable jaw faces offer many advantages to the careful workman. It is recommended that the three Prentiss "Ends" be always on hand and used with the same discrimination you would apply, say, to the selection of a milling tool.

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A good one for your driller, miller, shaper or planer.
The attachments mean that you can do much duplicate drilling without the cost of a jig.
Any vise will pay. More time is consumed in catching work than drilling it.

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List Prices

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One V-Jaw is usually sufficient per vise.

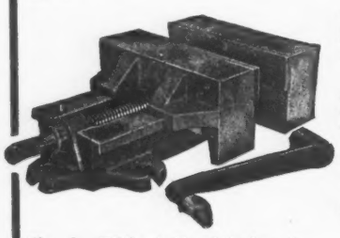


Fig. 2. Without Jig Attachments

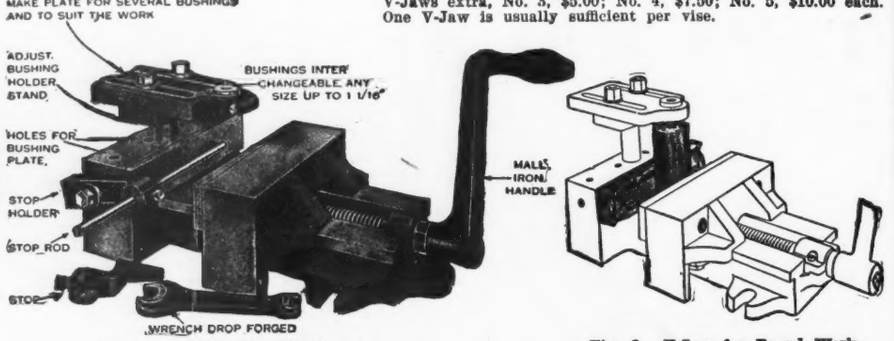


Fig. 1. With Jig Attachments

Fig. 3. V-Jaw for Round Work



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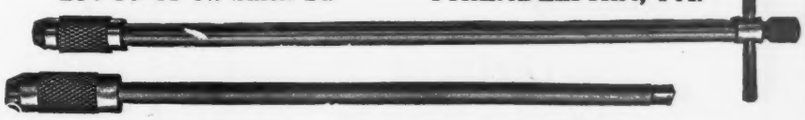


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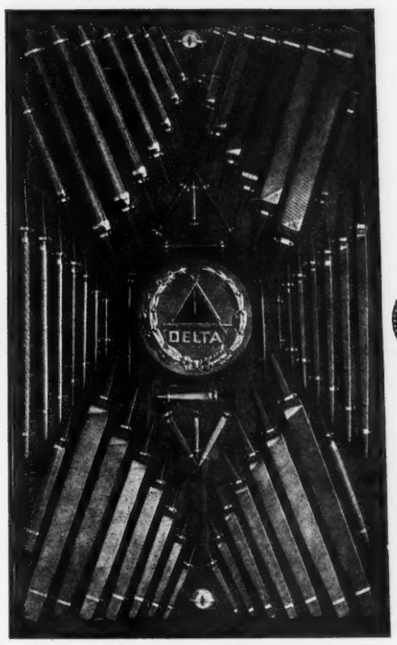
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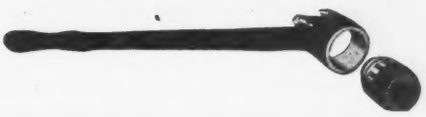
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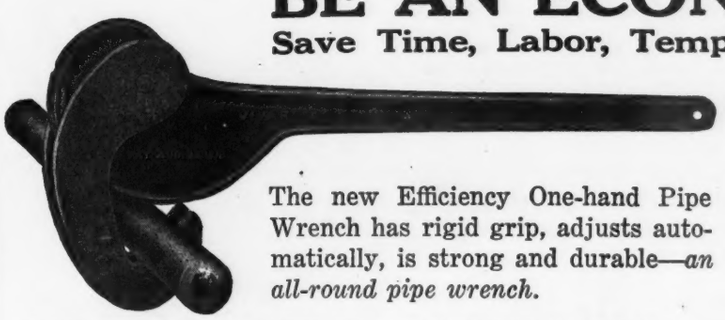
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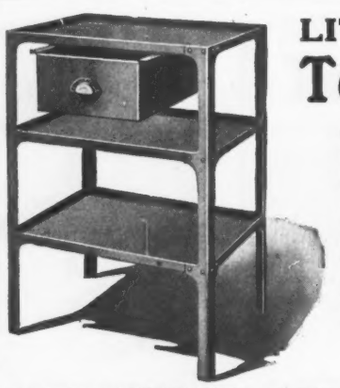
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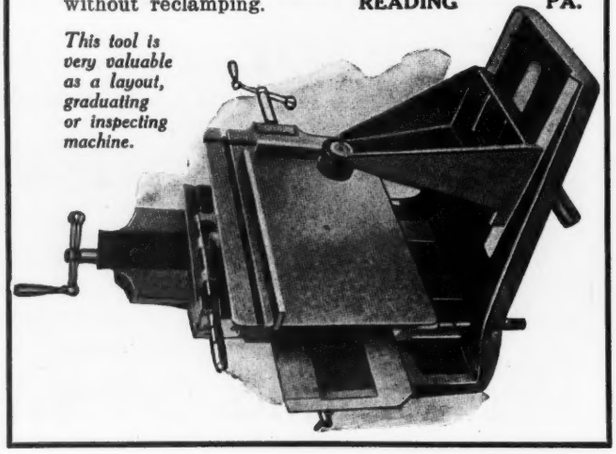
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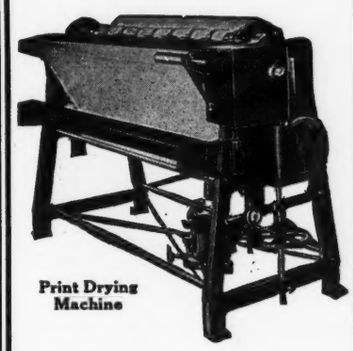
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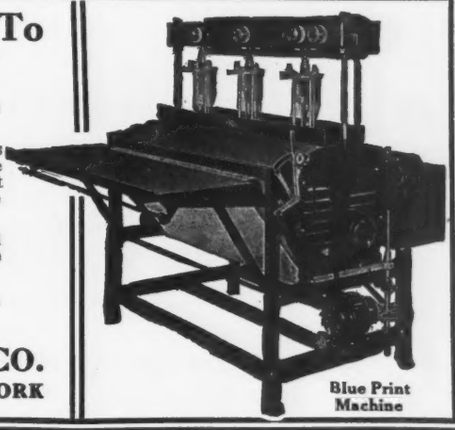
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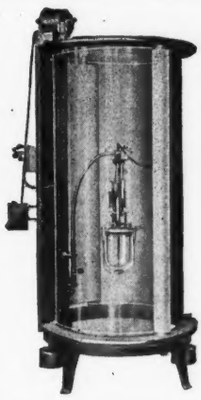
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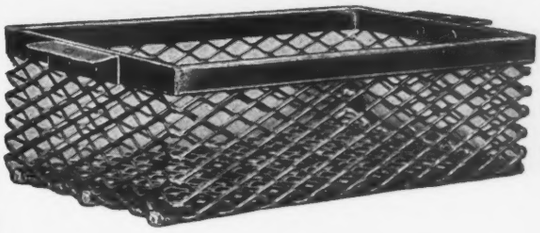
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Also plain or perforated styles, with or without skids. Furnished in gauges 1/8 inch thick and lighter, reinforced at top and corners. We can furnish these to suit your individual needs, and invite your inquiries. Machine Safety Guards, solid and expanded metal, Tool Cabinets, Factory Chairs, Forge Hoods, Grease Cans, Waste Cans, Skylights, Ventilators and special sheet metal work for factories. Let us solve your problems.

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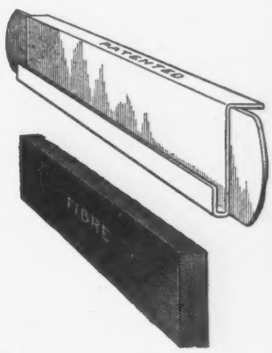
THE CANTON ART METAL CO.
Plants Nos. 1 and 2 CANTON, OHIO
New York Branch 497 WEST ST.

IDEAL VISE LINERS



Fibre or Brass Pads

ONCE TRIED—ALWAYS USED

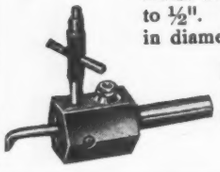


ORDER DIRECT OR FROM DEALERS

Hohnsbeen Manufacturing Co., Minneapolis, Minn.

R. W. RUNDE ECCENTRIC BORING HEADS

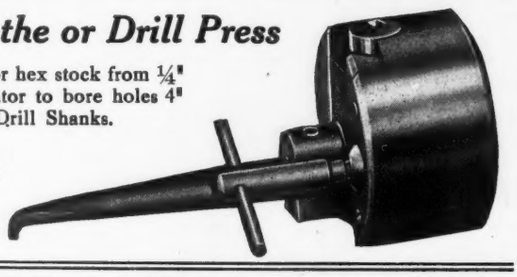
For Milling Machine, Screw Machine, Lathe or Drill Press



Made to take round stock from 5/16" to ¾" and square or hex stock from ¼" to ½". Slide has a travel of over 2" enabling the operator to bore holes 4" in diameter. Body is bored to fit No. 4 Morse Taper Drill Shanks.

Practical, convenient and economical devices that increase the range and production possibilities of standard machines.

SEND FOR THE DETAILS.



R. W. RUNDE MACHINE TOOL AND DIE WORKS
2669-71 E. GRAND BOULEVARD DETROIT, MICH.

HOLYOKE TRANSFER SYSTEMS

Simplify shop transportation. Holyoke Trucks—strong, simple, durable, with an easy roll lift, handle the heavily loaded platforms quickly and without difficulty, reducing the time and labor cost of moving the work as well as danger of damage to the work itself.

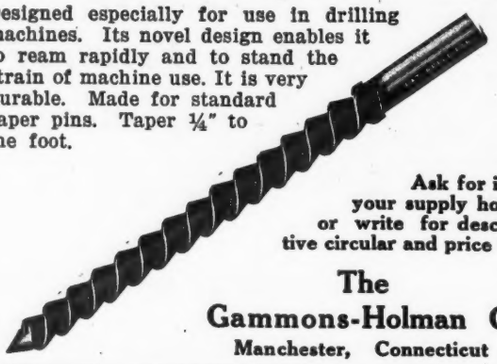
Stack your work on Holyoke Platforms—move them with Holyoke Trucks.



HOLYOKE TRUCK COMPANY
112 RACE STREET HOLYOKE, MASS.
Export Office: 77 Broad Street, New York City.
DISTRIBUTORS: New York City—Standard Scale & Supply Co., 145 Chambers Street; Philadelphia—Bartlett Factory Equipment Co., 3 North Twenty-first Street; Houston, Texas—American Warehouse Company; San Francisco—H. E. Hammond, Humbold Bank Bldg.; Detroit, Mich.—R. W. Wood Co., 327 Jefferson Ave., E.; Grand Rapids, Mich.—McMullen Machinery Company.; St. Louis, Mo.—J. H. Woolsey, 4552 Laclede Ave.; Kankakee, Ill.—Harold Copping, 533 Harrison Ave., Minneapolis, Minn.—Minnesota Concrete Steel & Specialty Company.

The Gammons Taper Pin Reamer

Designed especially for use in drilling machines. Its novel design enables it to ream rapidly and to stand the strain of machine use. It is very durable. Made for standard taper pins. Taper ¼" to the foot.



Ask for it at your supply house or write for descriptive circular and price list.

The Gammons-Holman Co.
Manchester, Connecticut

The WEAR-EVER ADJUSTABLE SPACING COLLAR

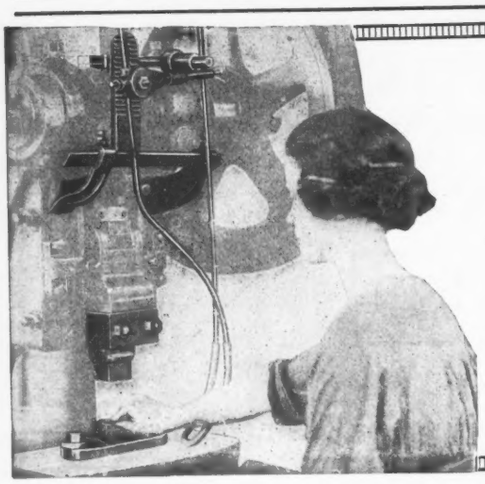
An Inexpensive Time Saver

Guarantees an accurate milling cutter set up. Nine sizes, ¾" to 2½" bore, easily adjustable in 12 steps of .002" each. Rigid as solid metal when set.

Circular?



SCULLY-JONES & CO.
647 Railway Exchange Bldg.
CHICAGO U. S. A.



IN PROTECTING YOUR EMPLOYES YOU ARE PROTECTING YOURSELF

Wiesman Safety Guards

Are Protection Insurance, and Safety for Power Press Operators

The device is so attached that the arm sweeps three-quarters of the way across the opening and well past the danger point during the first quarter of the stroke of the ram. It sweeps back four-fifths of the way on the third quarter of the stroke. Some of the features are that the guard possesses but two moving parts, consequently there is but little wear or need for frequent adjustment. It is positively automatic and does not interfere with the operator's work.

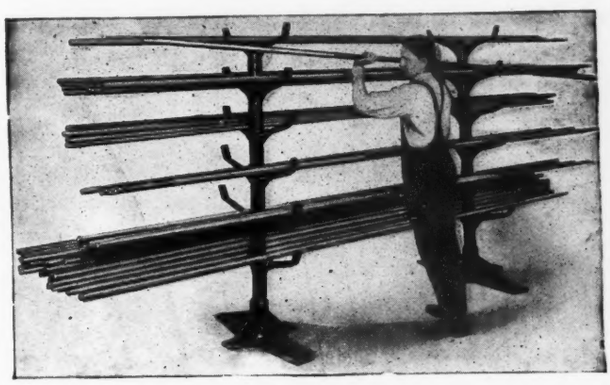
More particulars on request. Ask for our free trial offer, giving number and name of press.

WM. A. WIESMAN, 14 North Canal St., Dayton, Ohio

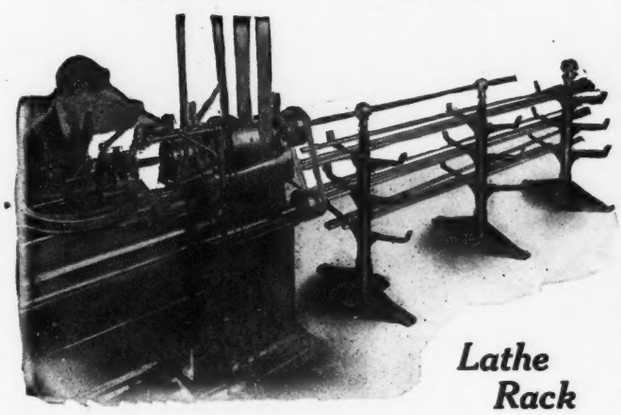
DISCOVERED!



"Yes sir, we discovered about twice the storage space in the same quarters. WHEN?—why, just as soon as we put in those *'sidelift'* BROWN SECTIONAL STOCK RACKS. They're saving time, temper and shoe leather, too."



Brown Sectional Stock Rack



Lathe Rack

Brown Sectional Racks are made of metal, built up of interlocking sections—can't lean, can't topple no matter how heavily laden—one man can assemble them.

Send for descriptive circular today.

BROWN ENGINEERING CO.
133 No. Third St. **READING, PA.**
2010-N



STYLE "A"

G & P
Universal Joints

A Size for Every Purpose

No matter what your universal joint requirements may be, we are ready to make prompt delivery.

We find from years of experience that it is a rare occasion when our standard stock sizes can not be used.

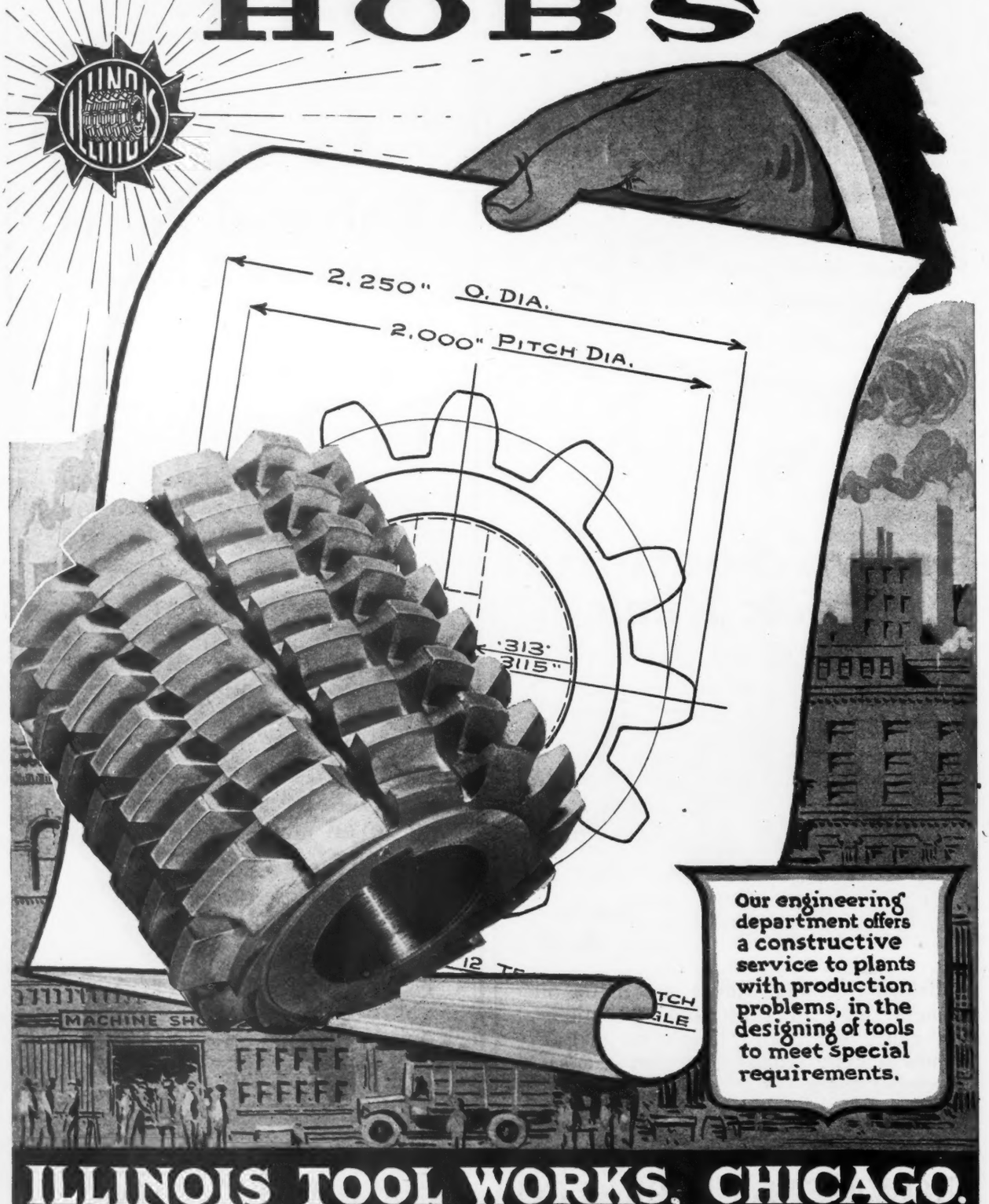
In the construction of G & P Universal Joints, all parts subject to wear are "case hardened," thus adding greatly to the life of the joint. Our style "A" universal joint (as shown above), comes with solid blank ends and is carried in seven sizes for immediate delivery.

Thousands of these joints are in daily use, and among our best customers are many who started using G & P Universal Joints when they were originally put on the market.

Write for circular

Manufactured by
GRAY & PRIOR MACHINE CO.
38 Suffield St., Hartford, Conn.

ILLINOIS HOBS



Our engineering department offers a constructive service to plants with production problems, in the designing of tools to meet special requirements.

ILLINOIS TOOL WORKS, CHICAGO.

Illinois Tool Works, Inc.
127-129 Water St., New York, N. Y.

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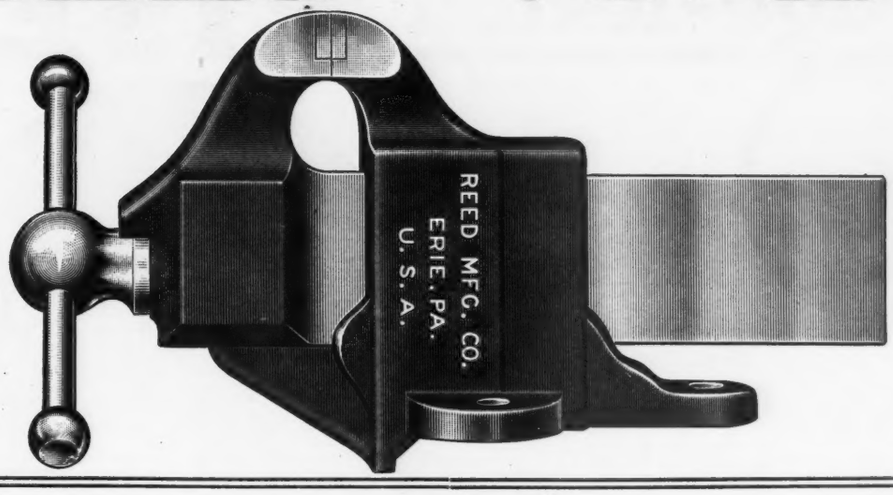
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Title Insurance Bldg., Los Angeles, Cal.

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616 Fletcher Savings & Trust Bank Bldg., Indianapolis, Ind.

Chas. A. Herstad
Copenhagen, Denmark.

REED VISES



The Primary Function of a Vise

A Little Essay Short Enough for Business Hours

Too many persons, in considering vises, seem to think that "a vise is a vise." Likewise "bread is bread," but there is a lot of difference. TOO FEW think of the effect a vise has on work done in it.

The primary function of a vise is to hold an object so that work may be performed on it. If the object be rigidly held all the force of the work performed is delivered to that object, but if the object is not rigidly held more or less of the work is spent for nothing—wasted through the springing of the vise or lost through its recoil. A good job of filing cannot be done in a vise which allows the object to vibrate and causes the file to chatter. Chipping or similar work cannot be efficiently done in a vise which does not wholly resist the shock of the hammer blows.

In the familiar effort of driving a nail through a thin wood partition the same principle is involved. Back the partition up with a heavy object and the nail goes through easily.

A vise must be sufficiently rigid to resist the working force exerted. This rigidity can be secured only through proper design and placing of material, ample weight, use of proper material, and careful workmanship. Weight in itself is of little effect unless properly placed. Cast iron of the best grade is the most rigid of all materials practical to use for vise making.

In making Reed Vises for many years, it has been our constant endeavor through careful investigation, elaborate tests, and close contact with users to develop vises of an ideal type.

Inasmuch as nothing in this world of ours is absolutely rigid, we can never hope to attain true rigidity. We have, however, developed our vises to the point where we feel no equal exists.

Reed Vises are made of the best grade of cast iron. Every contact point is painstakingly machined to close limits. This gives snug, easy working fit without undue wear at any point, and perfect interchangeability of parts. Good fit contributes much to RIGIDITY of Reed Vises.

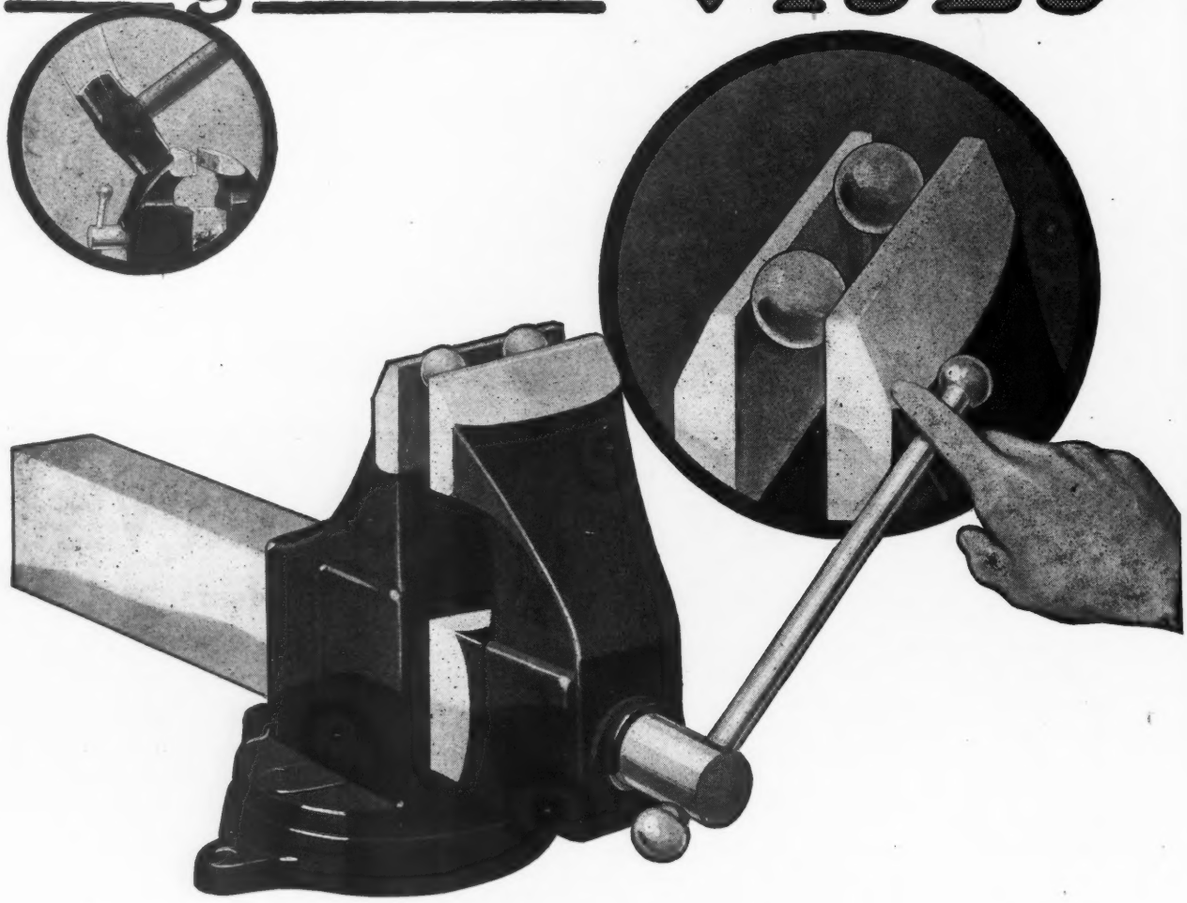
Weight is properly distributed to give greatest strength and rigidity. Because of the greater rigidity of a Reed Vise, the work performed is more quickly and efficiently done, and the life of the vise is greatly lengthened.

Widespread preference for Reed Vises is, we believe, based on our accomplishments.

REED MANUFACTURING CO., Erie, Pa.

COLUMBIAN

Sledge-Tested VISES



Will Your Vise Do This?

No one expects a vise to be made with micrometer accuracy. Yet the jaws of this Columbian Sledge-Tested Vise are so nearly parallel that when two steel balls of equal size are placed in the vise the minimum compression required to hold one ball will just be enough to hold the other.

This particular vise has smooth jaw facings, which makes the test more difficult than with the roughened jaws which are used on all Columbian Vises of machinists' type.

Of course, this is an unusual test for a tool with a tolerance of .002″ and it is likely that out of the hundreds of thousands of Columbian Vises in use the world over, there are some that will not easily stand so rigid a test, but the majority of Columbian Vises will.

Skilled mechanics demand the Columbian Vise for exacting work. The extra large, carefully fitted beam not only keeps the jaws parallel but slides freely and without play.

Columbian machinists' vises are the only malleable iron vises made and are twice as strong as cast iron. The famous Sledge-Test proves this.

Columbian Hardware Division
of **The Consolidated Iron-Steel Manufacturing Co.**
World's Largest Makers of Vises and Anvils
CLEVELAND

Greater Production

Accuracy and Efficiency are the Results in Every Manufacturing Plant Equipped With

This is the Tool You Want For Connecting Rod Boring



Eclipse

Interchangeable

BORING TOOLS

Counterbores Countersinks Spotfacers

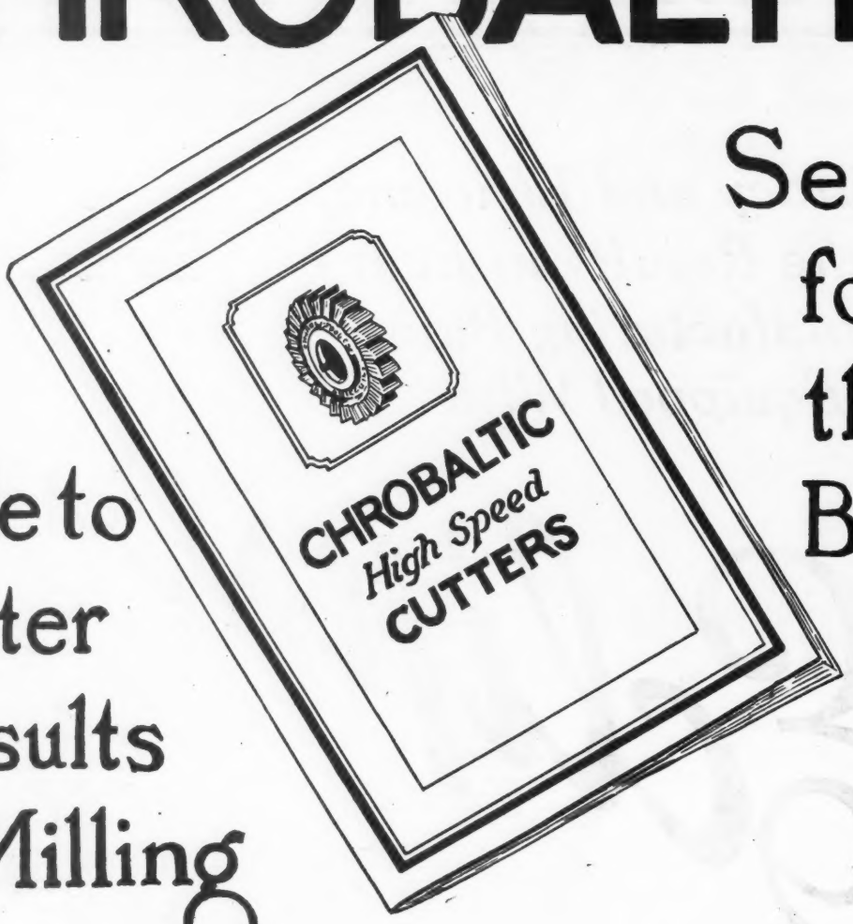
The Cost is Less Than Others
and the Production Greater

Write for catalog and discounts

THE ECLIPSE INTERCHANGEABLE COUNTERBORE COMPANY

1620 ST. AUBIN AVE. DETROIT, U. S. A.

CHROBALTIC



Send for this Book

Guide to Better Results in Milling

CHROBALTIC—A Forward Step Milling Cutter Practice

CHROBALTIC AND MONEL METAL

In tests made on Monel Metal by the Bethlehem Shipbuilding Corporation, Fore River Plant, Quincy, Mass., it was found that in comparison with ordinary high speed cutters, Chrobaltic cutters machined from two to three times as many pieces without regrinding.

In one of the tests a 4" diameter 5/8" face side milling cutter was used. At 115 R. P. M. and table travel 2½" per minute, it milled a cut 3/16" deep, removing .586 cubic inches of metal per minute.

If you are interested in milling, you should have the Chrobaltic Book and post yourself on the new alloy for present day requirements in this field.

Whether measured by quantity or quality of work performed—Chrobaltic high speed cutters are giving most satisfactory results; and they measure a positive forward step in milling cutter practice.

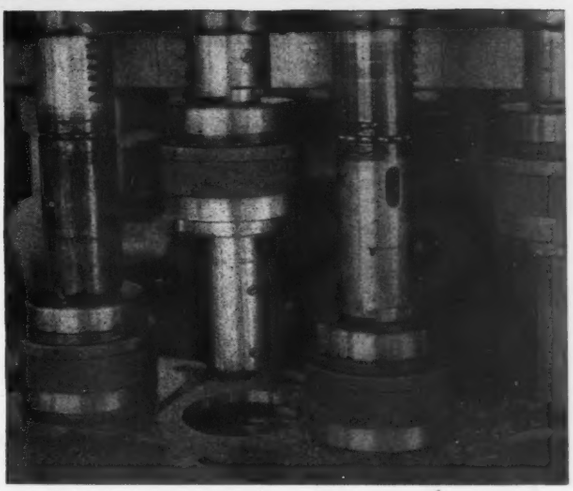
Chrobaltic Cutters distinguished themselves during the war, and they are now at the service and disposal of manufacturers who are looking for unusual results from milling cutters.

CHROBALTIC TOOL CO.

502 Railway Exchange CHICAGO

DAYLIGHT SAVING THAT'S WORTH WHILE





Boring and recessing bronze crank cases—in one operation

Kelly Production Tools

These Kelly Production Tools were photographed "in action" in a nationally famous automotive manufacturing plant.

These tools are doing, in a few minutes, work which formerly took close to an hour, and which would have occupied the time of expert mechanics, and besides this they insure duplication to a thousandth of an inch.

Kelly Production Tools are daylight savers which are truly worth while. We can furnish special tools to meet almost any production requirement on short notice. ***We Specialize on Boring and Reaming Tools.***

Get in touch with us, and let our engineering service show you what Kelly Tools will do for you. Send us your prints. No obligation incurred.

Our Catalog and photo albums are sent on request. We have district offices in principal cities.

THE KELLY REAMER COMPANY

Cleveland **3705 W. 73rd St.** **Ohio**



Guaranteed

To Increase Production 15 to 50 Per Cent.

We are ready, at all times, to stand behind this statement. We know what Cost-cutter Counterbores will do. Our customers have increased production from 15 to 50 per cent.

All we ask is this opportunity to prove our claim. There is no qualification to our guarantee—Cost-cut Counterbores must either increase production or the sale is not completed.

Under these terms we have been selling Cost-cut Counterbores for years, and we are yet to hear of one that has failed to make good, when operated under proper working conditions.

The cutter is the only part of a Cost-cut Counterbore that is subject to wear. Thus we figure that about 75 per cent of the complete Counterbore has indefinite life, and but one initial cost.

The cutter can be ground or resharpened over and over again, until it is entirely used up. These cutters are made in forty-four standard sizes, ranging in diameter from ¼″ to 3″.

It will pay you to look into this subject. Send for our Catalog.

COST CUTTER

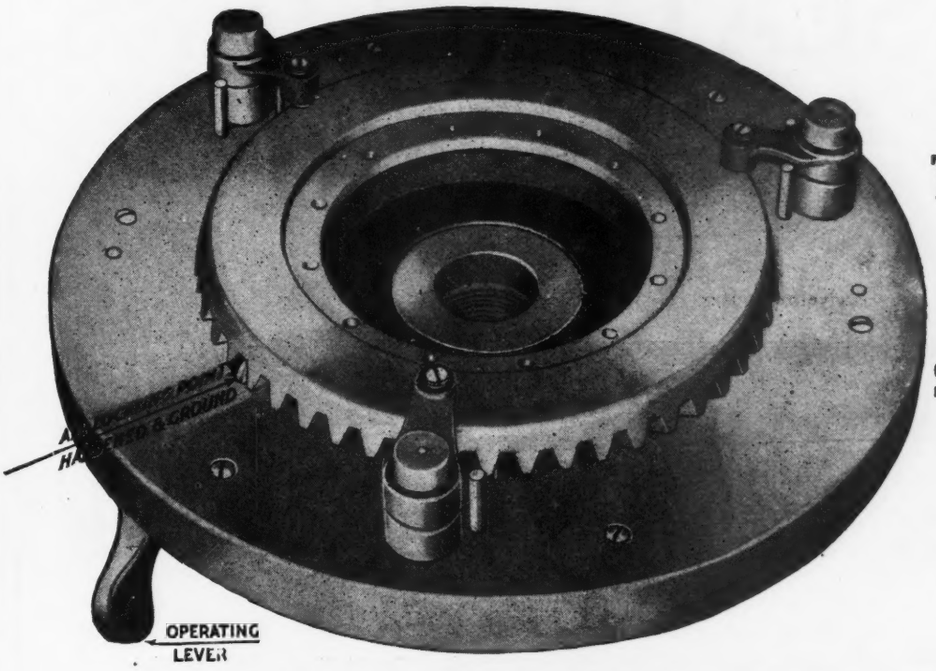
Cost-Cut Counterbore Company

DETROIT DEPT. A MICH., U. S. A.

These **GEAR CHUCKS** are but two of our complete line for **CHUCKING GEARS, SPROCKETS, SPLINES, WORMS AND WORM WHEELS** by the **PITCH DIAMETER**

ALL CHUCKS are simple but **VERY ACCURATE** and chuck **EXCEEDINGLY FAST** and also are designed as **FOOL PROOF** as possible.

Our chucks do not require skilled operators, and **RETAIN THEIR ACCURACY** through years of hard use. The above statements are evidenced by the numerous repeat and telegraph orders we receive.



The O. G. Bevel Gear Chuck

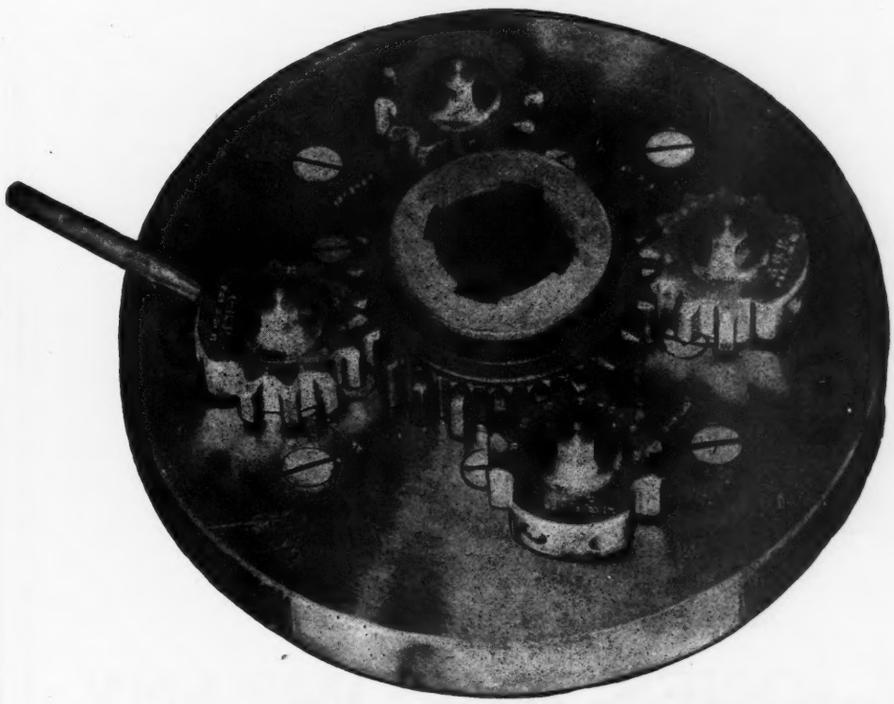
for both

SPUR and SPIRAL

Bevel Pinions and Gears

Chucks for any kind of Gear, Worm, Worm Wheel or Sprocket, regardless of pitch, type or size

AND THEY ALL CHUCK FROM THE PITCH DIAMETER



The Johnson Spur Gear Chuck

for

Spur, Spiral and Internal Gears

Send Blue Print of Those You Grind, for Quotations on Your Requirements.

GARRISON MACHINE WORKS, Dayton, Ohio

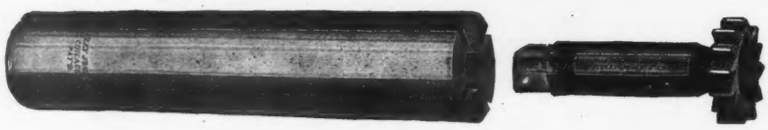
The Only Exclusive Gear Chuck Manufacturers.

SCULLY-JONES KEYSEAT CUTTERS

With Square Shanks



Drive by Square Center by Shank

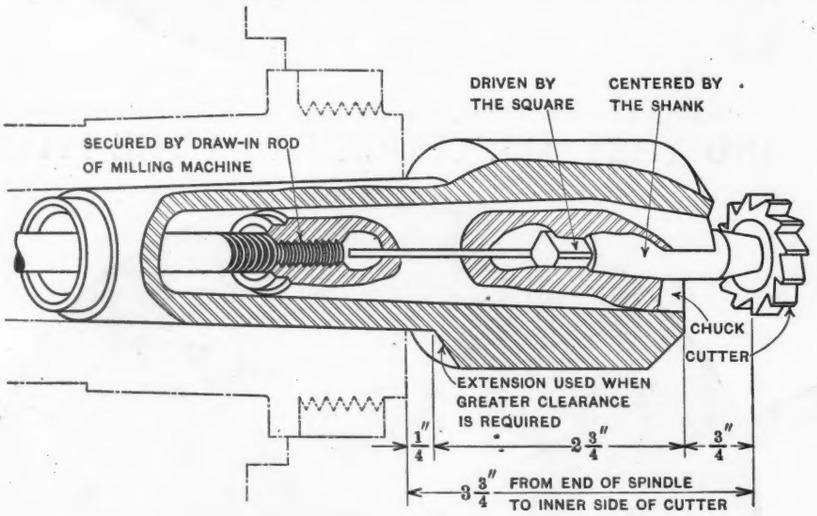


CHUCK FITS ALL SPINDLES

Made in One Piece

No Screws to Adjust

Cutter Cannot Slip



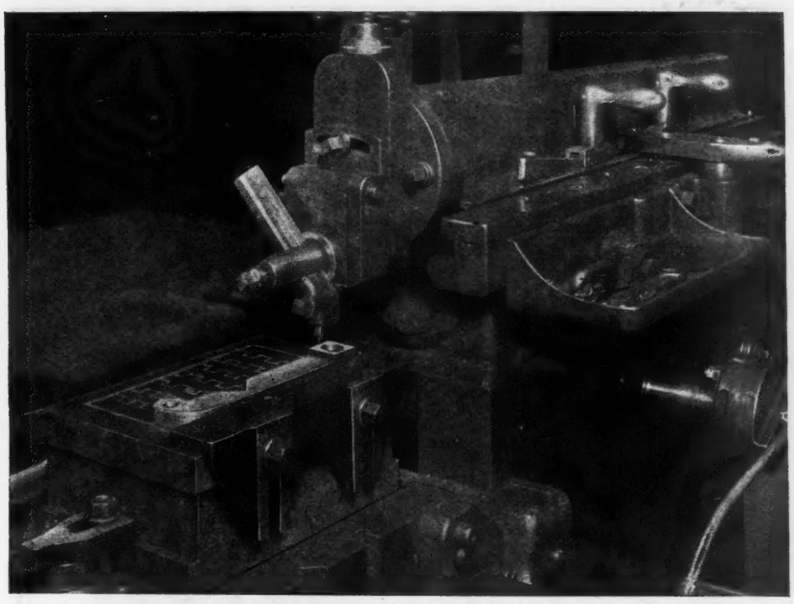


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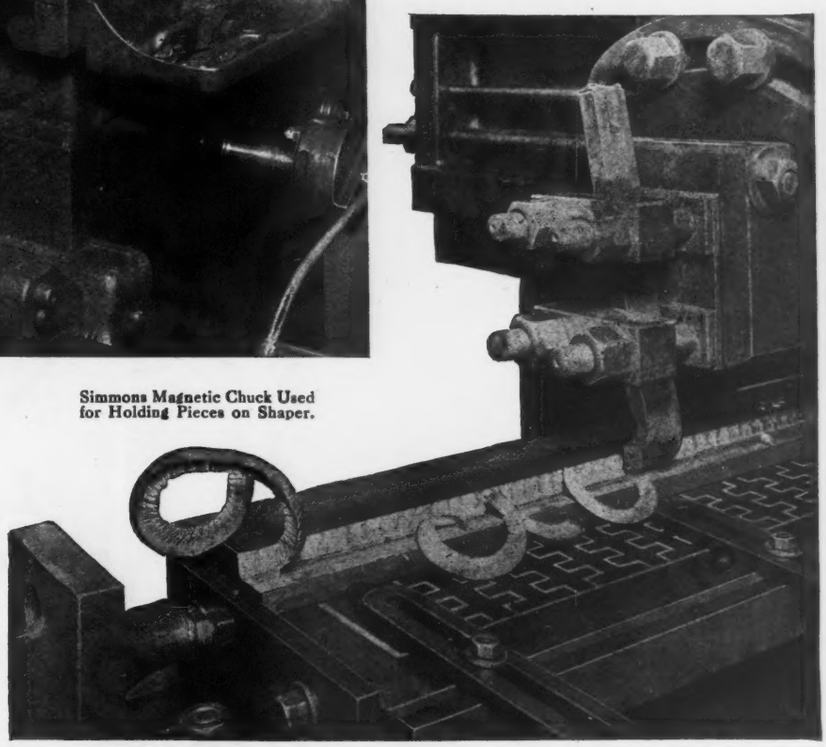
Mail us your order

SCULLY-JONES & COMPANY

647 Railway Exchange Building, CHICAGO ILLINOIS



TRADE T-P MARK



Simmons Magnetic Chuck Used for Holding Pieces on Shaper.

Simmons Unit-Pole Magnetic Chucks

The Simmons Unit-Pole Magnetic Chuck is a perfect work holder. All the drawbacks which formerly limited the use of chucks of this character have been eliminated.

In actual service this chuck is used in many ways to speed production by saving time. In the Simmons Chuck no magnetism "leaks" through the body to cause trouble. The magnetic circuit is a complete unit, separate and distinct from the chuck body.

As to heavy jobs, the 30-in. x 10½-in. rectangular chuck above held the piece of cold rolled steel against a pull that stalled the machine. The chip is ⅝ in. deep, 3/16 in. thick, the table feed 40 ft. per minute. The machine is a 30-in. Gray Planer, which "stalled" before the cut was finished, but the chuck did not yield its hold on the steel bar.

Simmons Unit-Pole Magnetic Chucks are adapted for a variety of uses. Safe, sure, economical from every standpoint. Write for descriptive bulletin 107-B.

THE TAFT-PEIRCE MFG. COMPANY

WOONSOCKET TRADE T-P MARK RHODE ISLAND, U.S.A. 2118A

New York: Woolworth Building Chicago First National Building Detroit: Majestic Building

TAFT-PEIRCE PRODUCTS CARRIED IN STOCK BY Syracuse Supply Co., Syracuse, Buffalo, Rochester; Cadillac Tool Co., Detroit; Sherritt & Stoer Co. Philadelphia; Wm. M. Pattison Supply Co., Cleveland; Northern Machinery Co., Minneapolis; Mid-West Machine & Tool Supply Co., Davenport, Ia.

"PRODUCTION"
Surface Milling Cutters



Adopted by the Mitchell Motors Company

Finishing the sides of the large ends of connecting rods is one of the ways in which "Production" Surface Milling Cutters are boosting production for the Mitchell Motors Co., Inc., Racine, Wis. A duplex indexing fixture is used enabling the operator to remove a completed connecting rod and clamp an unfinished connecting rod in place without stopping production.

The "Production" Cutter is 4⅛" in diameter and has 11 teeth of ⅜" tool bits. It runs 60 R.P.M., and the feed is 4½" per minute, or 0.075" per revolution of the cutter. About 1/16" material is removed from each side, and production runs 400 large ends per ten-hour day.

"Production" Surface Milling Cutters are equipped with either high-speed steel bits or Stellite blades.

Production Tools will increase your output—let us show you

PRODUCTION TOOL CO. OF AMERICA

Manufacturers of Surface Milling Cutters, Side Milling Cutters, Arbors, Spot Facers, Counterbores, Back Facers and Countersinks

DETROIT MICHIGAN

Fastfeed Drills Reamers and Cutters

are good, reliable tools because they are

—Made from the best tungsten tool steel,
—Heat treated by experts,
—Accurately machined,
—Rigidly inspected from first to last.

When in the market for production tools of guaranteed quality, GIVE FASTFEED TOOLS A TRIAL.

Fastfeed Drill and Tool Corporation

TOLEDO OHIO

New York Office, 21 Murray St.

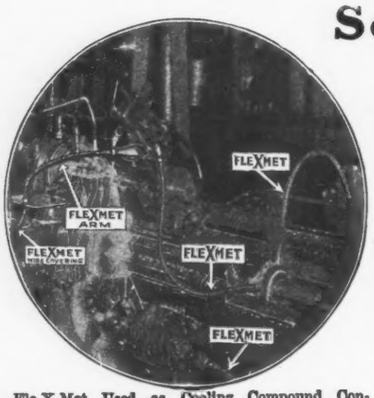


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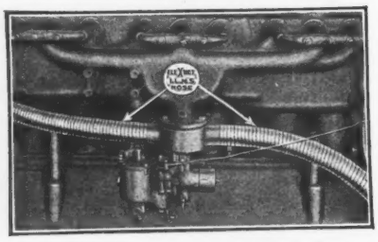
FLE X MET

Flexible Metal Hose

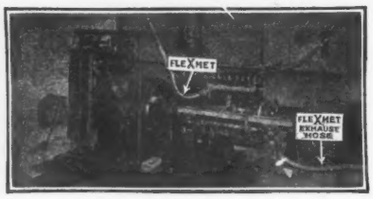
Some Typical Uses



Fle-X-Met Used as Cooling Compound Conveyor and as Flexible Arm for Adjustable Lamp.



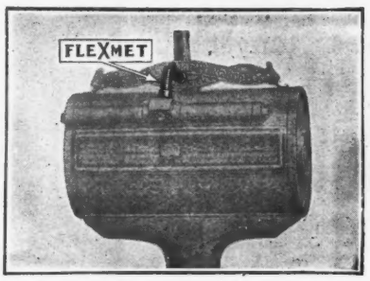
Fle-X-Met Used for High-Temperature Exhaust Lines on Thurston Fuel Gasifier for Low Grades of Fuel.



Fle-X-Met Used to Carry Exhaust Gases to Outside Air.



Fle-X-Met Used as Oil-Can Flexible Neck.



Fle-X-Met Arm Used on Scale Made by Standard Computing Scale Co.



YOU CAN USE FLE-X-MET

To Advantage
In the Shop or On Your Products

Fle-X-Met is made in any size, any length and of various metals to withstand the chemical action of most liquids, gases, etc., at various temperatures.

When packed, armored or packed and armored, it withstands high pressures and vacua. If unpacked and unarmored it, like all other metal flexible hose, cannot withstand pressures or vacua and is suited for conveyor casing and covering purposes only.

Only a few of the innumerable purposes to which Fle-X-Met is adapted can be shown here.

Do you want our 32-page Reference Book? It tells about flexible metal hose of all kinds.

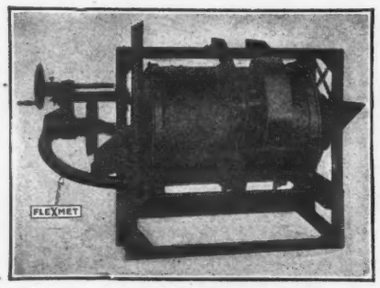
Write for our Prices and Samples.

They sell Fle-X-Met.

BREEZE MANUFACTURING CO.

Write for our Manufacturers' Sales Agents' Proposition. Give full particulars of the territory covered and lines carried.

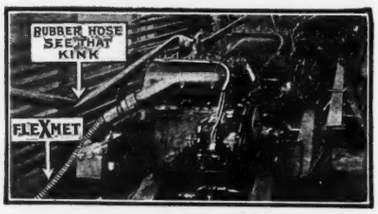
256 SOUTH STREET NEWARK, N. J.



Fle-X-Met Used as Dust Conveyor on Ideal Concrete Machinery Co.'s Tumbling Barrel.



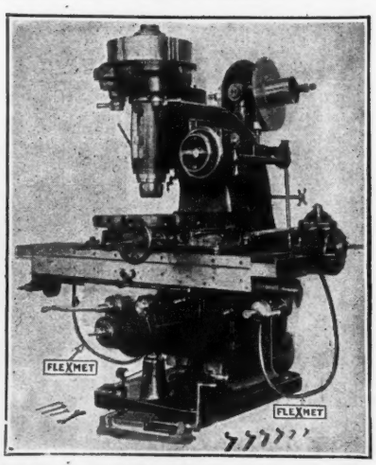
Rotary Ship-side and Boiler Scraper with Fle-X-Met I. L. N. S. Casing over Drive Shaft. Used by the U. S. Government for Cleaning Sides of Battleships.



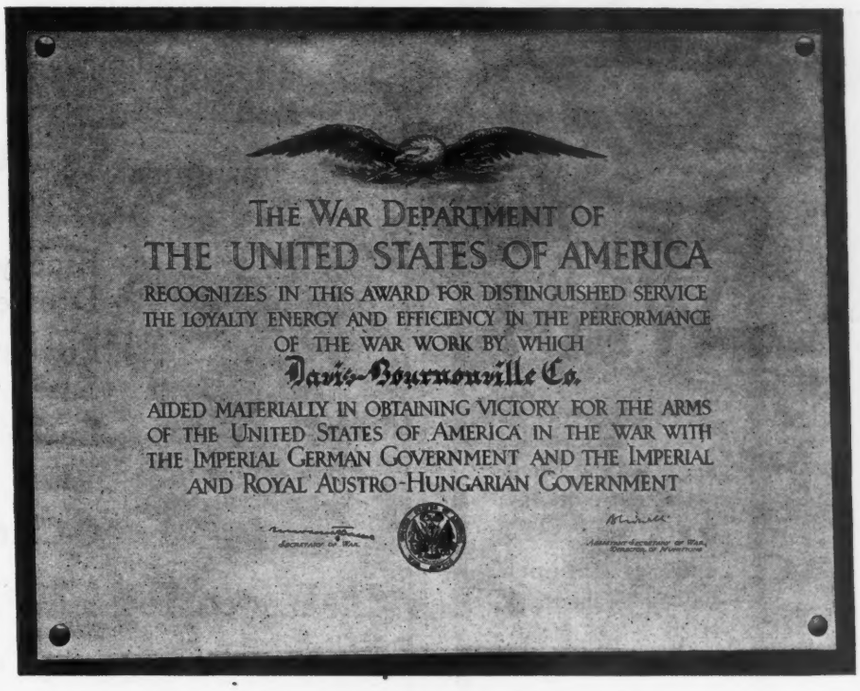
Fle-X-Met Used in Testing Room, Republic Motor Truck Co. Note the Kinks in the Rubber Hose.



Fle-X-Met Used for Conveying Oxygen and Acetylene in Oxy-acetylene Welding.



Fle-X-Met Used for Oil Drain Lines on Continuous Milling Machine.



Citation by U. S. War Department, January 31, 1920.

Commended by the U. S. War Department

The U. S. War Department bought more Davis-Bournonville oxy-acetylene and oxy-hydrogen welding and cutting apparatus than of all other makes combined.

This was doubtless due to two reasons: the reputation for efficiency established by long previous use of the company's product, and to official investigation of the company's facilities for production and service.

The Davis-Bournonville Company was and is the only concern in the industry supplying complete systems manufactured in its own factories, combining the production of acetylene, oxygen and hydrogen, portable and stationary welding and cutting outfits, and automatic and semi-automatic welding and cutting machines—the widest range of equipment manufactured for oxy-acetylene and oxy-hydrogen welding and cutting.

The requirements of the U. S. Government did not prevent the company from meeting greater demands than ever before from the commercial industries of the United States for its welding and cutting apparatus for use in "war work" in shipyards, munitions plants, and all metal-working industries. The value of the oxy-acetylene process in cutting and welding was so emphasized during the war period, that the demand for Davis-Bournonville equipment has progressively increased, and the output for the first half of 1920 to commercial industries is greater than in any previous year—a demand that is being met promptly through its great organization embracing branches in twenty principal cities of the United States and Canada.

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A list of users of Rich Tools would make a Blue Book of American Industry.

The exceptional staying qualities of Rich Tools, due to their tougher, denser structure, make them favorites where hard service is required.

Forged from the bar, twisted into shape, heat treated and ground to an accurate cutting edge, the result is a tool which can have no superior.

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Wizard Hack Saws are made to sell—on the theory that the best made tool sells best.

Wizard Saws are manufactured from the best tungsten steel with flexible soft back or all hard blade as desired. The number of teeth to the inch varies in accordance with material to be cut.

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No factory complete without one. Makes every kind of springs. Right or left-hand.

Capacity to 3/32 wire	$1.25
Capacity to 3/16 wire	2.50
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If interested, send for circular.



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SECOND HAND MACHINE TOOLS

BORING MACHINES

34″ Colburn vertical, turret head.
38″ Niles vertical, 2 hds.
42″ Bullard vertical, 2 hds.
Bement Miles horizontal, 2½″ bar.
No. 2—4″ Detrick & Harvey horizontal.
3″ Lucas horizontal, table type.

DRILLS

20″ Prentice Br. sl. hd., B.G.
42″ Cinn., sl. hd., B.G., tapping att., compound table.
24″ Pratt & Whitney, B.G., Power feed.
3 sp. Taylor & Fenn sensitive.
No 310 Baker Bros. high speed.
No. 37—16 spindle Natco multiple.
No. 12—12 spindle Natco multiple.
No. 12—12 spindle Natco multiple.
6 sp. Hendey, power feed to each spindle.

GRINDERS

10″ x 30″ Landis plain.
No. 4—12″ x 60″ Landis universal.
No. 3—12″ x 40″ Landis universal.
18 x 96 Norton, arr. for self-contained motor drive.
No. 18—12″ x 120″ Landis plain.
No. 6 Rivett internal.
26″ Blanchard H.P. vert., surface.

GEAR CUTTERS

No. 1 Dwight Slate auto. pinion.
34 x 10 B. & S. automatic spur.
24 x 12 G. & E. auto, gear hobbers.

LATHES

13″ x 6′ Willard C.R., P.C.F.
16″ x 6′ Porter, C.R., P.C.F., chuck.
16″ x 8′ Flather, P.C.F., C.R.
18″ x 6′ Hendey, taper att., C.R., P.C.F.
18″ x 8′ Prentice Bros., geared head, oil pan.
18″ x 10′ Reed. C.R., P.C.F.
18″ x 8′ Fitchburg, C.R., P.C.F.
20″ x 19″ F. E. Reed, C.R., P.C.F.
26″ x 12′ Putnam, C.R., D.B.G.
32″ x 14′ Hamilton, triple geared headstock, set of raising blocks, C.R., P.C.F.
38″ x 20′ New Haven, C.R., P.C.F.

MILLERS

20″ x 20″ x 8′ Ingersoll slab miller.
No. 14 Garvin plain.
No. 2 Cincinnati plain.
No. 2A Kempsmith plain.
No. 1½ LeBlond univ., motor drive.
No. 4B Becker vertical.
No. 5-C Becker vertical.
No. 5 Hendey Lincoln type.
No. 3 Cincinnati high power vertical.
No. 4 Cincinnati high power vertical.

PLANERS

24″ x 24″ x 6′ Putnam, one head.
24″ x 24″ x 6′ Flather, one head.
30″ x 30″ x 8′ Pond, 2 heads.
30″ x 30″ x 8′ Cleveland openside, 2 heads on cross rail, one side head.
48″ x 48″ x 16′ Sellers, 3 heads.
60″ x 60″ x 14′ Gleason, 2 heads.

SHAPERS

15″ Hendey, motor driven.
20″ Milwaukee crank, vise.

SCREW MACHINES AND TURRET LATHES

1¾″ Bardons & Oliver turret.
No. 3 Windsor wire feed screw machine.
No. 2½ Garvin single geared screw mach., with air chuck.
2″ x 24″ J. & L. turret lathe with bar equipment.
3″ x 36″ J. & L. turret lathe with bar equipment and chucking equip.
16″ Acme universal turret.
24″ Gisholt turret lathe, 6½″ H.S.
24″ Steinle heavy turret lathe.
½″—4 spin. National Acme.

MISCELLANEOUS

Broaching Machine, No. 5 J. N. Lapointe.
Broaching Machine, No. 4 J. N. Lapointe.
Keyseater, No. 2 Baker Bros.
Pipe Machine, 4″ Curtis & Curtis.
Slotter, 14″ stroke Betts.

HENRY PRENTISS & COMPANY

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149 BROADWAY NEW YORK

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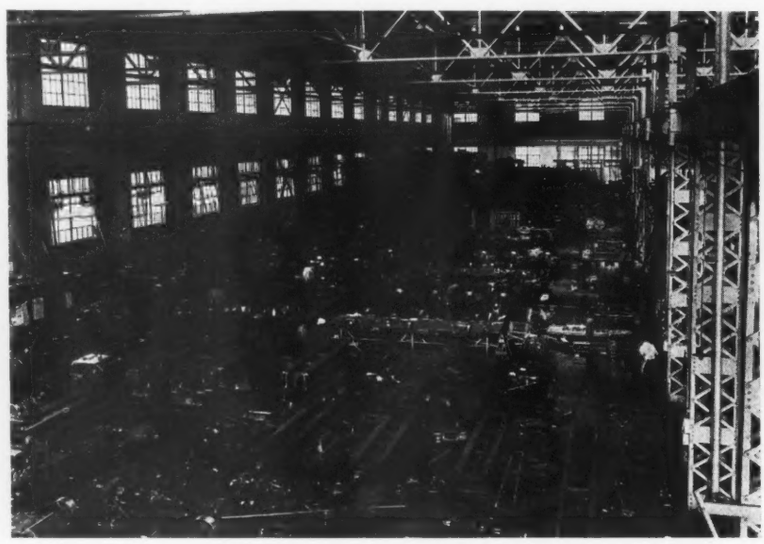
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TRADE MARK

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You always got MORE FOR YOUR MONEY when you bought RE-MANUFACTURED MACHINES. But now you get MORE for LESS money. We are buying only LATE MODEL machines and only those which we can sell at REAL BARGAIN PRICES. We aim to give you RE-MANUFACTURED machines, which compare favorably with NEW, at prices even lower than you pay for ordinary used machines.



One Section of Our Re-manufacturing Shop

Briefly outlined, the Re-manufacturing process is as follows: Every machine which is to be Re-manufactured is completely taken apart even if practically new. Flat surfaces are hand scraped to Brown & Sharpe Surface Plates. Cylindrical Bearings are renewed when necessary, then accurately aligned under the supervision of experts.

Old enamel is completely removed, then renewed, and bright parts are polished.

Results—a machine outwardly and inwardly "new." Hence the unconditional Hill Clarke guarantee.

LATHES

1—45" x 24' Pond Trip. Gd. C.R.
4—40-in. x 18-ft. Fifield Engine Trip. Gd., C.R.
4—40-in. x 12-ft. Fifield Engine, Trip. Gd., C.R.
2—36-in. x 19-ft. Johnson Trip. Gd. Motor.
3—36-in. x 14-ft. Johnson Trip. Gd. Motor.
23—32-in. x 12-ft. Pittsburgh Engine. C.R., Q.C.G.
5—30-in. x 11-ft. American Gd. Hd. Engine, C.R., Q.C.G.
5—26-in. x 20-ft. Bridgeport Engine. D.B.G., C.R., Q.C.G.
10—26-in. x 18-ft. Bridgeport Engine. D.B.G., C.R., Q.C.G.
20—26-in. x 12-ft. Bridgeport Engine. D.B.G., C.R., Q.C.G.
75—26-in. x 10-ft. Bridegport Engine. D.B.G., C.R., Q.C.G.
3—26-in. x 10-ft. Putnam Motor Driven Engine. C.R.
30—26-in. x 10-ft. Niles Engine. D.B.G., C.R., Q.C.G.
10—25-in. x 10-ft. LeBlond Engine. D.B.G., C.R., Q.C.G.
52—21-in. x 10-ft. LeBlond Engine. D.B.G., C.R., Q.C.G.
99—20-in. x 8-ft. American Engine. D.B.G., C.R., Q.C.G.
16—20-in. x 8-ft. American Engine. D.B.G., C.R., Q.C.G., P.F.T.
3—20-in. x 8-ft. American Gd. Hd. Engine.
14—20-in. x 8-ft. LeBlond Engine. D.B.G., C.R., Q.C.G.
30—19-in. x 8-ft. LeBlond Engine. D.B.G., C.R., P.F.T.
44—19" x 8' LeBlond Engine. D.B.G., C.R., Q.C.G.
14—18-in. x 8-ft. LeBlond Engine. D.B.G., C.R., Q.C.G.
8—18-in. x 8-ft. Boye & Emmes. D.B.G., C.R., Q.C.G.
21—18-in. x 8-ft. Boye & Emmes. D.B.G., C.R., belt.
12—17-in. x 6-ft. LeBlond Mfr's. Automobile.
7—16-in. x 6-ft. Reed Engine. C.R.
42—14-in. x 6-ft. Reed Ex. Hvy. Pl.

SHAPERS

2—24-in. Rockford.
1—26-in. Springfield.
9—26-in. Niles-Bement-Pond.
1—28-in. Gould & Eberhardt.
1—24" x 24" x 6' American.
2—36-in. x 13-in. x 14-ft. Niles Frog.
1—56-in. x 56-in. x 10-ft. Gray.

TURRET LATHES

5—19-in. LeBlond Universal.
34—19-in. LeBlond Combination.
16—20-in. American Combination.
12—21-in. LeBlond Universal.
32—24-in. Steinle.
3—24-in. Gisholts.
3—No. 3-A Warner & Swasey.

MILLING MACHINES

10—No. 6 Whitney Hand.
5—No. 3½ Fox.
1—No. 2 Becker Plain.
2—18-in. Cincinnati Auto Millers.
3—No. 7-H Becker Lincoln.

BORING MACHINES

1—3½-in. bar Binsse Horizontal.
1—4-in. bar Niles Horizontal.
1—2-spindle Beaman & Smith Cylinder.
1—34-in. Bullard.

DRILLS

1—No. 2-K Henry & Wright.
1—No. 4-B Henry & Wright.
2—No. 6-B Henry & Wright.
4—3-ft. American Sensitive.
1—3-ft. Fosdick Radial.

GRINDERS

1—8-in. x 48-in. Thompson Surface.
1—No. 2 Bath Surface.
1—No. 10 Brown & Sharpe Pl.
1—No. 70 Heald Internal.

MISCELLANEOUS

1—2¼-in. Cleveland Automatic.
4—6-in. x 14-in. P. & W. Thread Miller.
1—30-in. Flather Gear Cutter.

OUR GUARANTEE: YOUR MONEY BACK IF YOU RETURN MACHINE WITHIN 30 DAYS OF DATE OF SHIPMENT, FREIGHT PREPAID NO EXCUSES! NECESSARY!

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THIS IS "GRAVES" LIST
A Selection From 476 Machines

8-5C Becker Vertical Milling Machine, New—$500 below to-day's price.
84-in. x 84-in. x 10-ft. Sellers Planer, 4 heads.
48-in. x 48-in. x 14-ft. Powell Planer, 4 heads, almost new, heavy type, with new reversing type motor, complete.
48-in. x 48-in. x 16-ft. Bement-Miles Planer, 4 heads.
6-ft. Niles-Bement-Pond Full Universal Radial Drill, motor driven (D.C.)
6-ft. Dreses Full Universal Radial Drill, motor driven (D.C.)
6-ft. Baush Radial, heavy type.

Now What About the Following Selections from Our 476 Machines

VERTICAL BORING MILLS

100-in. Betts, three heads. Very heavy.
76-in. Betts, 2 swivel heads.
60-in. Niles-Bement-Pond, 2 swivel heads, S.P.D., good as new.
60-in. Bickford, two heads.
48-in. Colburn, 2 swivel hds., rapid traverse.
36-in. Bullard Vertical Turret Lathe, side head type.

GEAR CUTTERS

60-in. x 8-in. Gould & Eberhardt, spur gears.
36-in. x 10-in. Gould & Eberhardt, spur.
36-in. x 10-in. Flather.

GRINDERS

No. 28 Brown & Sharpe, 18-in. x 96-in., good as new, weighs 18,000 lbs.
Landis 10-in. x 36-in., Universal.
No. 23 Brown & Sharpe, Cylinder.
No. 5 Bath Duplex, complete.
No. 15 Besley Pattern Makers, Disc (30-in.)

ENGINE LATHES

60-in. x 20-ft. Fifield, C.R., P.C.F. Motor Driven.
48-in. x 20-ft. Fifield, C.R., P.C.F.
42-in. x 21-ft. New Haven, C.R., P.C.F.
36-in. x 16-ft. Niles, C.R., P.C.F.
36-in. x 14-ft. Putnam, heavy duty, taper att.
36-in. x 12-ft. Pond, motor or belt drive.
30-in. x 12-ft. Israel Johnson, heavy duty.
20-in. x 8-ft. Lodge & Shipley, geared head, S.P.D.

PUNCHES AND SHEARS

32-in. Sellers Punch and Shear. Punches 2-in. hole thru 1½-in. thickness. Shears 2½-in. round. Very heavy type.
Carlin Alligator Shear. Cap. 5-in. rounds.

MILLING MACHINES

Two (2) 50-in. x 8-ft. Ingersoll Slab Millers.
No. 3 LeBlond, high power, geared head.
No. 3 LeBlond, plain, all geared feeds.
No. 3 Hendey, plain, geared feeds.
No. 24 Brown & Sharpe, 81-in. table.
No. 2 Hendey, plain.
No. 7H Becker, Lincoln Type, like new.
Two (2) No. 6 Whitney Hand Millers, like new.

PLANERS

48-in. x 48-in. x 14-ft. Powell, 4 heads.
42-in. x 42-in. x 12-ft. Pond, 2 rail heads.
36-in. x 36-in. x 18-ft. Pease, 2 rail heads.
36-in. x 36-in. x 12-ft. Niles-Bement-Pond, 2 rail, 1 side head.
30-in. x 30-in. x 6-ft. Gray, 1 rail, 2 side hds.

PRESSES

No. 512 Bliss Special Triple Acting. 33 tons pressure, excellent condition.
Five Farrell D.A.—1 to 3-in. strokes.
DD4 Ferracute, roll feed, double acting, open back inclinable.

MISCELLANEOUS

25 lb. Bradley Helve Hammer.
3¼-in. Gridley Automatic, complete with 2 motors.
No. 2 Barrett Horizontal Boring Machine, 5-in. bar. Heaviest pattern, 98% new; full equipment.
5 Baush Multiple Drills, five, six and eight spindles.
8-in. Newton Slotter, like new.
Two (2) 2-in. x 24-in. Jones & Lamson Turret Lathes, Geared Head.

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2—12" x 4' Mulliner Lathes, with quick change gear, compound rest.
12" x 4' Mulliner Lathe, with quick change gear, compound rest, and taper attachment.
14" x 6' Monarch Lathe with compound rest, loose change gears.
14" x 6' Bradford standard engine lathe, with compound rest.
2—14" x 6' Bradford standard engine lathes, with taper attachment and compound rest.
16" x 8' Reed Lathe, with elevating rest.
15" x 6' Old Style Blaisdell lathe, with rise and fall rest.
17" x 6' LeBlond Heavy Duty Manufacturing Lathe, with turret on car.
18" x 14' Bradford Standard Engine Lathe, with compound rest.
19" x 10' LeBlond Heavy Duty Manufacturing Lathe, with plain rest, longitudinal stops, taper attachment.
25" x 12' American Tool Works' Geared Head Lathe, single pulley drive, compound rest, quick change gear.
30" x 10' Niles-Bement-Pond Double Back Geared Motor Driven Engine Lathe.
36" x 16' Niles-Bement-Pond Triple Geared Motor Driven Engine Lathe.

PLANERS AND SHAPERS

12" Cincinnati Crank Shaper.
14" Juengst Shaper.
30" x 30" x 8' Whitcomb-Blaisdell Planer with two heads on cross rail.

DRILLS

Three-spindle 16" Sipp High Speed Ball Bearing Drill.
2-ft. arm Fosdick Radial Drill.
3-ft. arm Bickford Radial Drill.
6-ft. arm Niles-Bement-Pond Universal Radial Drill with 220 volt D.C. motor.

GRINDERS

No. 1 Norton Universal Tool and Cutter Grinder.
10 x 20 Acme Universal Tool and Cutter Grinder.
No. 11-B Brown & Sharpe Plain Grinding Machine.
12" x 24" Landis Grinding Machine.

MILLING MACHINES

12" x 36" Eynon & Ingersoll Slab Milling Machine.
No. 2 LeBlond Universal Milling Machine.
No. 2-H Becker Vertical Milling Machine with rotary.
2—Sloan & Chace Hand Millers.

GEAR CUTTING, HOBBING AND SHAPING MACHINES

No. 3 B. & S. Spur Gear Cutting Machine.
2—Fellows Gear Shapers.

SCREW MACHINES AND TURRET LATHES

3—2¼" Single Spindle Gridley Automatic Screw Machines.
No. 6—2¼" capacity Warner & Swasey Turret Lathe with automatic chuck and wire feed and power feed to turret; oil pan, pump and tools.
2 x 24" Jones & Lamson Flat Turret Lathe.

MISCELLANEOUS

48" Bertsch Power Gap Squaring Shear.
Houghton & Richards Band Saw Machine.
2—10" Niles-Bement-Pond Vertical Slotters.
2½" bar Niles cone type horizontal boring machine.
4-spindle Whiton Centering machine.
4 x 80 Pratt & Whitney Thread Miller.
Waltham Thread Miller.
200-lb. Beaudry "Champion" Power Hammer.
300-lb. Beaudry "Champion" Power Hammer.
Electromobile Truck, carrying capacity 3000 lbs.; pulling capacity 10,000 lbs., two 4-wheel wagon trailers and charging outfit.
Type 3-V.S.-23 National Brake & Electric Co.'s Motor Driven Air Compressor; having a piston displacement of 300 cu. ft. per minute against 90-lb. pressure; including 54 H.P. Allis-Chalmers 3-phase 60 cycle 200 volt A.C. motor.. Type HB control; comprising automatic governor, unloader and water valve; all mounted on common bed-plate making complete self-contained unit.

22"x84" PRATT & WHITNEY Surface Grinder: Size of Table, 22"x84". 3⅝" T-slots. Travel of table, 84". From centre of wheel spindle to column, 20⅛". From table to face of wheel up, 18". Size of pulley on wheel spindle, 9"x22". Equipped with 1—40 HP Westinghouse Motor and Starting Box; 220 volts, 3-phase, 60 cycle, type C.S.; 1—12"x24" Heald Magnetic Chuck, type 1224 No. 20, 220 volts; Pump Tank and Water Guards. Weight 17,000 lbs. In excellent condition.

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CLEVELAND *Machinery Department* OHIO, U. S. A.

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First Class Used Tools

FOR PROMPT DELIVERY

BALANCING MACHINE

1—66" Norton Running Balance Indicating Machine.

BORING MACHINES

1—20" Baker Cylinder Borer.
1—42" Bullard.
2—54" Bullards.

CUTTING OFF MACHINE

1—2" Rogers Cutting Off Machine.

DRILLING MACHINES

1—26" Aurora Sliding Head.
1—46" Henry & Wright Radial.
2—No. 1 S Garvin Duplex.
1—4' Cincinnati Bickford Radial—Speed Box Drive.

GEAR CUTTERS

2—36 x 9 Gould & Eberhardt Horizontal Type Automatic.
1—No. 2 Whiton Automatic.

GRINDERS

1—No. 20 Bryant Semi-Automatic Cylinder Grinder.
3—No. 18 Bryant Semi-Automatic Cylinder Grinder.
2—10 x 24 Norton Special Purpose.
1—No. 2 Leland & Faulconer Double Wheel Wet Grinder.
1—No. 2 Wilmarth & Morman.
2—No. 1 Cincinnati Cutter and Tool Grinders.
1—Blanchard Vertical Surface Grinder.
2—No. 10 Bryant Semi-Automatic Cylinder Grinders.

HAMMERS

1—No. 35 Williams & White Tire Welding.
1—No. 4 Champion.

KEYSEATER

1—No. 2 Baker Keyseater.

LATHES

6—8 x 60 Lo-Swing Lathes.
1—16 x 8 Draper 3-step cone double back geared engine lathe.
1—26 x 10 Reed Lathe.

MILLING MACHINES

3—No. 2 Cincinnati Plain High Power
2—No. 7 Becker Lincoln Type
2—No. AB-1 Becker High Power Vertical
1—6 x 29 Brown & Sharpe Plain
1—No. 1 Brown & Sharpe Plain
1—No. 2 Brown & Sharpe Vertical
1—No. 3 Brown & Sharpe Vertical
2—No. 2 Cleveland Plain
1—No. 14 Garvin
1—8" Pratt & Whitney Automatic
6—No. 6 Whitney Hand
1—No. 10 Moline Thread Miller
1—Taft Pierce Thread Miller

PISTON RING MACHINES

3—Gridley Plain Automatic
2—Gridley Eccentric Automatic

PLANERS

10—30 x 30 x 14' Cincinnati Heavy Pattern—two heads.
1—24 x 24 x 6' Whitcomb—one head

PROFILERS

3—2-Spindle Pratt & Whitney with 12 x 15 tables.
1—No. 12 Single Spindle Leland & Gifford
1—No. 3 Single Spindle Garvin

SCREW MACHINES

1—No. 55 Acme Automatic
1—3" Foster Screw Machine
1—2" Cleveland Automatic.

TURRET LATHES

6—24" Gisholts
1—4 3/16" Bardons & Oliver

We Rebuild the Tool. *We Purchase Modern Tools.*

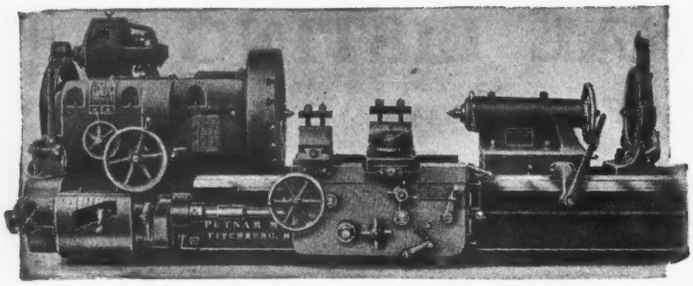
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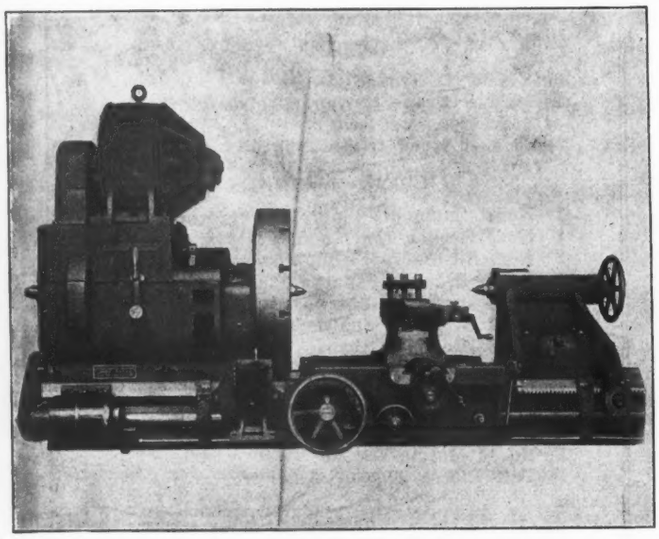
THE MOTCH & MERRYWEATHER MACHINERY CO.

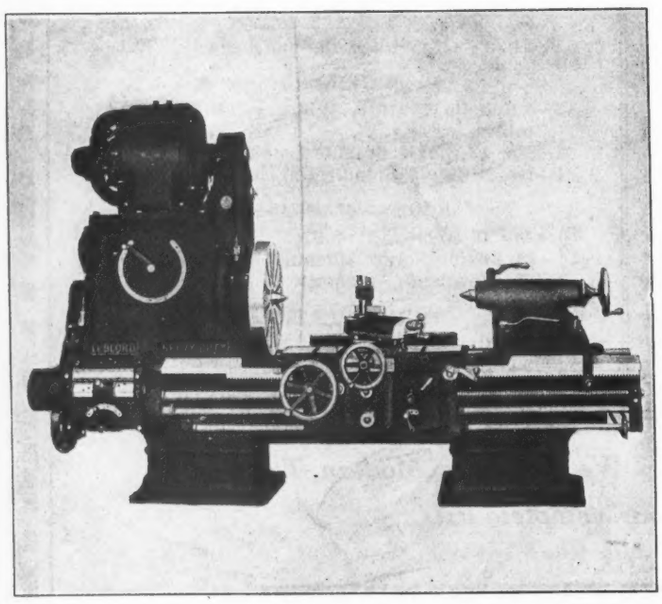
711 LAKESIDE AVENUE, N. W. CLEVELAND, OHIO

Branches:

CINCINNATI DETROIT PITTSBURGH







SIMM RELIA— MACHINE

SPECIALS

15—27″ x 18′ LeBlond All Geared Head Lathes, motor drive, 220 volt D.C.
1—48″ x 56′ Niles-Bement-Pond, all geared head, arranged for motor drive.
1—60″ x 60″ x 20′ Woodward-Powell Planer, 4 heads.
3—36″ x 36″ x 20′ Woodward-Powell Planer, 4 heads.
1—42″ x 42″ x 12′ Simmons Openside, 2 heads, new.
3—36″ x 14′ Putnam Lathes, all geared head, motor drive.
1—48″ x 56′ Bridgeford Lathe all geared head, motor drive.
No. 5 Brown & Sharpe Universal Grinder.

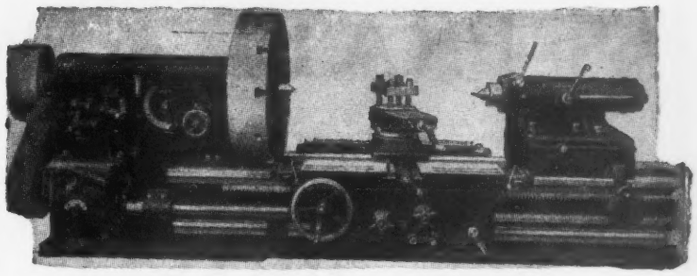
LATHES

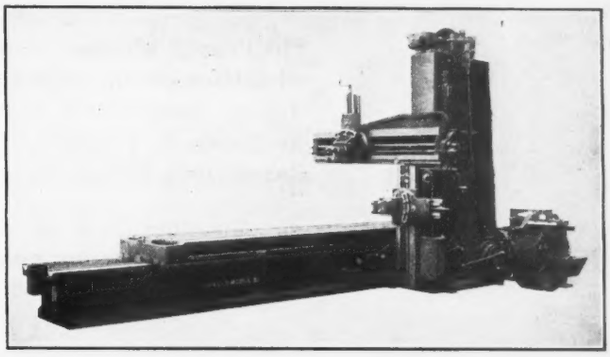
1—New 84″ x 25′ Putnam All Geared Head Lathe, steel gears throughout, with 35 hp. 230 variable speed motor.
1—84″ x 30′ Niles-Bement-Pond High Duty Lathe.
60″ x 30′ Niles-Bement-Pond High Duty Lathe.
1—64″ x 51′ Detrick & Harvey Lathe, all geared head, arranged for motor drive.
2—48″ x 54′ Bridgeford Lathes, all geared head, arranged for motor drive.
9—48″ x 56′ Niles-Bement-Pond, all geared head lathe, arranged for motor drive.
2—48″ x 32′ Bridgeford, all geared head, arranged for motor drive.
3—New 36″ x 40′ Bridgeford Lathes, all geared head.
1—42″ x 18½′ New Haven, all geared head, arranged for motor drive.
3—36″ x 14′ Putnam Lathes, all geared head, motor drive, 220 volt DC.
2—36″ x 18′ American, all geared head, motor drive, 220 volt DC.
1—New 30″ x 34′ American Lathe, taper attachment, gelt drive, double carriage.
1—36″ x 38′ Pittsburgh, all geared head, arranged for motor drive, two carriage.
1—New 36″ x 18′ Putnam, belt drive complete.
15—27″ x 18′ LeBlond, all geared head, motor drive, 220 volt DC.
4—32″ x 25′ Ricon, Shafting Lathes, all geared head, arranged for motor drive.
1—28″ x 18′ Pond Lathe, all geared head, arranged for motor drive.
2—24″ x 10′ Greaves-Klusman, High Duty complete.

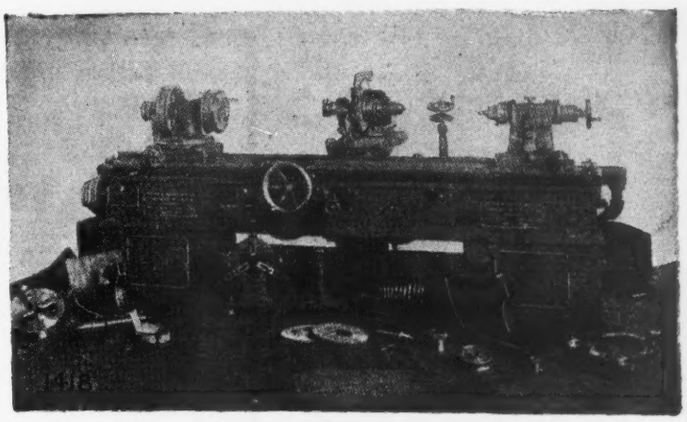
SIMMONS MACHINE COMPANY

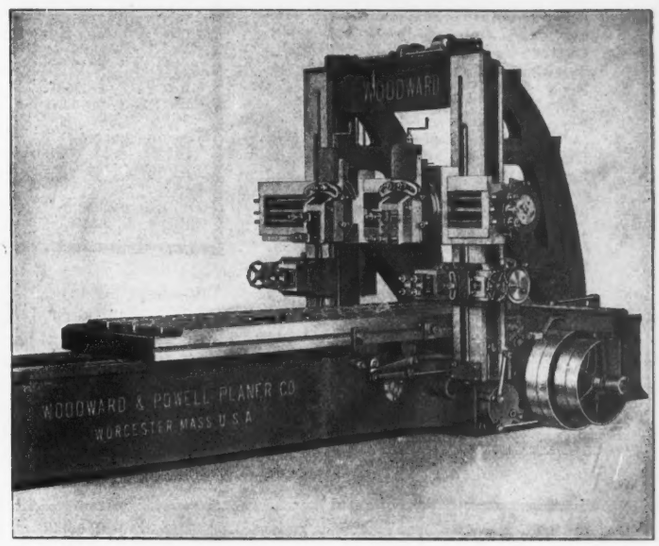
BRANCH OFFICES: 801 Singer Building, New York, N. Y.

ONS -BUILT TOOLS









BORING MILLS

1—New 36″ Bullard New Era Type Vertical Boring Mill, complete with four jaw chuck, 10-15 hp. 230 volt motors, 1100 rpm., with lubricant system.
1—72″ Cincinnati Vertical Boring Mill, two swivel heads.
1—Beaman-Smith Horizontal Boring Mill, 3″ bar.

PLANERS

1—60″ x 60″ x 20′ Woodward-Powell Planer, 4 heads, reversing type 220 DC motor.
1—New 48″ x 48″ x 28′ Cincinnati, 2 heads, reversing type 220 volt DC motors.
1—New 48″ x 48″ x 14′ Cincinnati Planer, 2 heads, arranged for motor drive.
1—New 48″ x 48″ x 20′ Niles-Bement Pond Planer, 4 heads, belt drive.
1—48″ x 48″ x 20′ Ridgeway Planer, 3 heads, motor drive.
1—New 42″ x 42″ x 12′ Simmons Openside Planer, 2 heads.
3—36″ x 36″ x 20′ Woodward-Powell Planers, 4 heads, motor drive.
1—30″ x 30″ x 18′ Cincinnati Planer, two heads.

RADIAL DRILLS

1—5′ Prentice Plain Radial Drill, arranged for motor drive.
1—7′ Warren Semi-Universal Radial Drill, arranged for motor drive.
1—Four Spindle Harrington Adjustable Head Drill.
2—20″ Barnes Drill Presses.

MILLERS

1—No. 2 Brown & Sharpe Vertical Miller.
1—Model B Gooley-Edlund Miller.
1—No. 5 Brown & Sharpe Plain Miller.
1—Pratt & Whitney Heavy Duty Slab Miller.
25—Whitney Standard and Becker Hand Millers.
2—No. 5 Brown-Sharpe Vertical Millers.

MISCELLANEOUS

10—32″ Cincinnati High Duty Shapers, complete.
1—No. 4 La Pointe Broaching Machine.
1—No. 1 La Pointe Broaching Machine.
2—36″ Fellows Gear Shapers.
1—No. 2-A Warner-Swasey Turret Lathe, complete with bar equipment.
1—96″ Gould & Eberhardt Gear Hobber.
1—New 14″ x 96″ Norton Plain Grinder.
1—18″ x 96″ Norton Plain Grinder
1—18″ Betts Slotter Complete.

Write for Complete List

INC., ALBANY, N. Y., U. S. A.

86-88 Exchange Street, Buffalo, New York

PRATT & WHITNEY

STANDARD AND SPECIAL

MACHINERY

The Pratt & Whitney Standard and Special Machines advertised on this page are offered for sale by negotiation. Proposals to purchase should be addressed to Chairman, Rochester District, Ordnance Salvage Board, 1044 University Ave., Rochester, N. Y.

The Machines listed as "Special" were designed for special war work, but may be readily converted into standard machines.

23 Gun Barrel and Tube Drilling Machines, 2 Spindle, 9½ ft. bed. No. 1 Location: Savage Arms Corp., Utica, N. Y. Maker, Pratt & Whitney Co.

23 Gun Barrel and Tube Drilling Machines, 2 Spindle 6 ft. Bed. Location: R.O.S.D., Rochester, N. Y. Maker, Pratt & Whitney Co.

79 Gun Barrel and Tube Drilling Machines, 2 Spindle, 9½ ft. bed. Location: R.O.S.D., Rochester, N. Y. Maker, Pratt & Whitney Co.

44 Form Turning Machines. Used for turning Gun Stocks. May be used for turning any forms. Approximately 6" in dia. 4' lengths. Equipped with copying device, head and tail stock for Form Driving head and tail stock for work. Cutter head approximately 8" in dia. Location: R.O.S.D., Rochester, N. Y. Maker, Pratt & Whitney Co.

15 Grinding Machines, Small Belt Driven Bench Grinders, Bench Lathe type bed. Cross slide and compound rest, grinding head with pinion and quadrant. May be adapted for grinding small cutters. Location: R.O.S.D., Rochester, N. Y. Maker, Pratt & Whitney.

6 Gun Barrel Drill Grinders. Location: R.O.S D., Rochester, N. Y. Maker, Pratt & Whitney.

4 Profiling Machines, one-spindle No. 13. Location: R.O.S.D., Rochester, N. Y. Maker, Pratt & Whitney Co.

Special Machinery of Other Makes

14 Engine Lathes. 14" x 6'. Equipped with Special Carriage. Without Tail Stock, Lead Screw and Gears and Automatic Power Feed. Location: Curtiss Plant, Buffalo, N. Y. Maker, Hendey Machine Co.

65 Special Single Purpose Lathes. 20" x 8' 2 Step Cone, Double Back Geared. Cross Slide and Compound Rest. Longitudinal and Automatic Feed. Six feed changes. Location: Curtiss Plant, Buffalo, N. Y.

6 Special Single Purpose Lathes, 20" x 8' tight and loose pulley drive, fixed gear reduction. Carriage equipped with special cross traverse tool slide, longitudinal and cross traverse hand feeds, longitudinal automatic fixed feed with fast reverse or vice versa, including automatic stops. Provided with special tail stock which sets in three fixed positions. Location: Curtiss Plant, Buffalo, N. Y. Maker. Duff Mfg. Co., Pittsburgh, Pa.

40 Turning Lathes. Used for turning Gun Barrels. Max. Swing. 8" x 5' Bed. Equipped with Sprocket and Feed Tension Pulleys. Brackets and Feed Chain for carriage. Location: R.O.S.D. Rochester, N. Y. Maker, Providence Engineering Works, Providence, R. I.

29 Straightening Machines, Gun Barrel or Shaft Straightening Fixtures. Mounted on Column 5 ft. high. Adjustable for height and swung into vertical or horizontal position. Location: Curtiss Plant, Buffalo, N. Y. Maker, Carter & Hakes, Winston, Conn.

This equipment is ready for immediate delivery. Terms of sale are not complicated. For full directions to purchasers, and for details of the large assortment of materials and equipment in the Rochester District, write for the District Bulletin.

3 Profiling Machines, two-spindle No. 13. Location: R.O.S.D., Rochester, N. Y. Maker, Pratt & Whitney Co.

26 Profiling Machines, special six spindle. Used for bedding barrel into gunstock. Equipped with bedding fixtures and cutters. Location: R.O.S.D., Rochester, N. Y. Maker, Pratt & Whitney Co.

65 Spline Shaving Machines, ¾" double head. Max movement of table 12". Operated by crank and adjustable connecting rod. Location: Curtiss Plant, Buffalo, N. Y. Maker, Pratt & Whitney Co.

10 Reaming Machines. Gun Barrel two spindle 8½ ft. bed. Max. capacity 13/16" x 36". Location: Savage Arms Corp., Utica, N. Y., Maker, Pratt & Whitney Co.

14 Reaming Machines, Gun Barrel two spindle 8½' bed. Max. capacity 13/16" x 36". Location: R.O.S.D., Rochester, N. Y. Maker, Pratt & Whitney Co.

53 Rifling Machines, Gun Barrel single spindle No. 3. Location: R.O.S.D., Rochester, N. Y. Maker, Pratt & Whitney Co.

11 Rifling Machines, Gun Barrel, four spindle No. 3. Location: Savage Arms Corp., Utica, N. Y. Maker, Pratt & Whitney Co.

2 Tapping Machines, horizontal. Will take No. 2 Taper Shank Chuck. Location: R.O.S.D., Rochester, N. Y. Maker, Pratt & Whitney Co.

Rochester District Ordnance Salvage Board

1048 University Avenue *Telephone Chase 4480* **ROCHESTER, NEW YORK**

You Might Find It Here

PLANERS

Hendey 22″ x 22″ x 5′. One Head. Friction Type.
Powell 30″ x 30″ x 8′. Two Heads on rail.
Woodward & Powell 30″ x 30″ x 8′. Two Heads on rail.
Putnam 48″ x 48″ x 18′. Two Heads on rail.

TURRET LATHES AND SCREW MACHINES

Jones & Lamson 2″ x 24″ Flat Turret Lathe with Bar Outfit.
Jones & Lamson 3″ x 36″ Flat Turret Lathe with Bar and Chucking Outfit.
Pratt & Whitney No. 2 Hand Screw Machine.

GRINDING MACHINES

Norton Emery Wheel Co., Universal Cutter & Tool Grinder.
Oesterlein No. 2 Universal Cutter & Tool Grinder.
Modern No. 12 Plain Grinder; Capacity, 5″ x 30″.

SHAPERS

Smith & Mills 14″ Plain Crank Shapers.
Ohio 22″ Back Geared Crank Shaper.

MILLING MACHINES

Oesterlein No. 20 Universal. Cone Drive. Back Geared.
Oesterlein No. 20 Plain. Cone Drive. Back Geared.
Oesterlein No. 24 Plain. Cone Drive. Back Geared.
Dow No. 1 Plain Milling Machine. 24″ Feed. Back Geared.
Becker Model "AB" Vertical Milling Machine. Without Rotary.
Hendey No. 2½ Lincoln Type Milling Machine.
Pratt & Whitney No. 0 Hand Milling Machines. Power Feed.

MISCELLANEOUS

Niles 60″ Vertical Boring & Turning Mill. Two Swivel Heads.
Dreses 4′ Plain Radial Drilling Machine.
Bement 6″ Slotting Machine.
J. N. Lapointe No. 1 Broaching Machine.

This is only a partial List

HILL, CLARKE & COMPANY, Inc.

The Machinery Merchants

156 OLIVER STREET **BOSTON 9, MASS.**

Telephone, Main 4438

NEW MACHINERY USED MACHINERY

DAY MACHINERY CO.

BUFFALO, N.Y.

6—24″ Bullard New Era Type Vertical Turret Lathes. Belt driven. Three jaw chuck table.

1—42″ Bullard New Era Type Vertical Turret Lathe. Motor driven. Three jaw chuck table.

1—42″ Putnam Vertical Boring Mill. Two swivel heads. Power rapid traverse. Belt driven. Latest Type.

2—No. 2-G Brown & Sharpe Automatic Screw Machines.

1—Model C-2 Becker Vertical Miller. No rotary. Arranged for motor drive.

1—5′ American Full Universal Radial Drill. Arranged for motor drive through gear box. Latest type.

Over Sixty Radial Drills Available
Sizes 2½′ to 6′

15 Ingersoll Millers Available

Complete Machine Shop Equipment

What Have You for Sale? Send Us Your Inquiry

4—3″ x 36″ Jones & Lamson Flat Turret Lathes. Chucking equipment. Latest type.

1—24″ x 10′ Greaves-Klusman Heavy Duty Lathe. Quick change geared. Three step cone. Double back geared. With full swing rest.

3—No. 3 Baush Multiple Spindle Drills. Thirty ½″ dia. spindles. 20″ x 40″ rectangular head.

2—2000 lb. Chambersburg Steam Drop Hammers.

2—3000 lb. Chambersburg Steam Drop Hammers.

Used Machinery For Sale

1—2¾″ bar Binssee Horizontal boring Mill.
1—10 x 30 Landis Plain Grinder.
1—No. 2 Hendey-Norton Plain Milling Machine.
1—No. 2 B. & S. Universal Milling Machine.
1—10 x 30 Landis Universal Grinder.
3—24″ Fellows Gear Shapers.
1—No. 23 New Britain Automatic Chucking Machine.
1—No. 4A High Speed Riveting Hammer.
Several 5A and 6A Potter & Johnson Automat.
Several National Acme Automatics.
Several No. 6 Whitney Hand Millers.

VONNEGUT MACHINERY CO., Indianapolis, Ind.

This List Should Help You

5—Single Spindle Bench Buffing Heads.
1—"Lodge & Shipley" 16x6′ Tool-room Engine Lathe; T. A. Draw-in Attachment Chucks.
2—77x8′ "Sidney" H.D. 2 C.C.R. Lathes.
1—"Bridgeford" 36″x24′ Geared Head High Duty Engine Lathe C.R. T.A. Motor Drive with 25 H.P. Motor.
1—"Brown & Sharpe" Vertical Milling Machine with 18″ Circular Attachment.
1—"Brown & Sharpe" No. 1 Universal Grinding Machine.
1—18′ Niles Plate Planer for ¾′ plates, belt driven, in excellent condition.
1—Bennett O'Connell Buffing Machine, 1 spindle.
1—Blount 14″ Wet Tool Grinder.
3—No. 6 Whitney Hand Millers.
1—Lincoln Type Mitts & Merrill Slab Milling Machine, Automatic Feed.
1—54x44x6 Gray Planer, 4 heads.
1—62″ Niles Boring Mill, 2 Swivel Heads.
1—Ferracute Kick Press, Type F.
2—17x6 LeBlond Turret Lathes. Carriage Turrets and Air Chucks.
1—24x26′ Porter Q.C. Engine Lathe.
1—15x6′ Von Wyck Engine Lathe, C.R.
1—No. 2 Fosdick Horizontal Milling Machine.
1—Wilmarth & Morman Style J Drill Grinder.
1—No. 1½ "Landis" Internal Grindle.
1—No. 2 "Landis" Internal Grinder.
1—17x6′ "LeBlond" Turret Lathe.
1—No. 00 "Baker" Keyseater.

THE E. A. KINSEY COMPANY, CINCINNATI INDIANAPOLIS

P. D. Q.

That's how we are Compelled To Dispose of over $300,000.00 Worth of Practically New Machinery

The result is that we are offering some very unusual bargains on lathes, millers, profilers, grinders, tanks, blowers, pumps, screw machines, nailing machines and presses.

Send us your requirements, we have it or can get it. Let us prove this assertion.

SAXER MACHINERY CO.
ERIE PENNA.

UNUSUAL OFFERINGS
In
New and Second Hand High Grade Modern Machine Tool Equipment

Consisting of 1500 Items **All Styles and Sizes**

Barnes Drills.
Natco Adjustable Spindle Drills.
Baker Heavy Duty Drills.
Berlin Bracket Drills.
Superior Drills.
American Lathes.
Reed Prentice Lathes.
Lodge & Shipley Lathes.
Walcott Lathes.
Fitchburg LoSwing Lathes.
Gisholt Automatic Lathes.
Potter & Johnston Automatic Lathes.
J & L Turret Lathes.
Libby Turret Lathes.
Bullard Turret Lathes.
National Acme Turret Lathes.
Cleveland Automatic Turret Lathes.
Universal Automatic Turret Lathes.
Gridley Automatic Turret Lathes.
Cincinnati Automatic Milling Machines.
Kempsmith Milling Machines.
Becker Vertical Milling Machines.
Ingersoll Milling Machines.
Lees-Bradner Hob Mills.
Gould-Eberhardt Hobbing Machines.
Fellows Gear Shapers.
New Britain Automatic Screw Machines.
Norton Grinders.
Bryant Chucking Grinders.
Gardner Disc Grinders.
Besley Disc Grinders.
Blanchard Vertical Grinders.
Landis Internal Grinders.
Heald Grinders.
Rivett Internal Grinders.
Davis Keyseaters.

Already 25 carloads have been unloaded in our warerooms and many more are in transit. Complete detailed lists are being prepared and will be sent on request. Let us have your inquiries?

PENINSULAR MACHINERY COMPANY
279 E. Jefferson Ave. DETROIT, MICHIGAN

UNITED STATES NAVY
LATHES LATHES
TURNING AND BORING

The Navy Department has for sale a large number of lathes, which were used for ordnance work during the war. The majority of these are turning and boring lathes with a few engine lathes. All of the lathes may be used for heavy duty work, with swing from 18 inches to 42 inches and bed plates from 28 ft. to 66 ft.

These lathes are of the following manufacture:—

LEBLOND **BRIDGEFORD** **PUTNAM**
AMERICAN **McMYLER** **POND**
RITTER & CONLEY **ELECTRIC DRIVE**

These lathes may be inspected at naval stations near Philadelphia and near New York. For further information and detailed description address:—

COMMANDER G. M. STACKHOUSE (SC) U. S. N.
Senior Member, Board of Survey, Appraisal and Sale
LEAGUE ISLAND NAVY YARD PHILADELPHIA, PENNSYLVANIA
Bell Telephone: Dickinson 6300, Branch 557

Phone: Franklin 5899
Complete list now ready.

568 West Washington Boulevard
Mail us your inquiries.

NEW, USED AND REBUILT MACHINERY for Immediate Delivery

LATHES

2" x 24" J. & L. Turret Lathe (new)
3½ x 60 Lo-swing Lathe.
No. 2 Niles Axle Lathe.
No. 3 Niles Axle Lathe.
13 x5 Willard Lathe, S.Q.C.G.
14 x 5 Willard Lathe, S.Q.C.G.
14 x6 Springfield Lathe, Taper Attach.
14 x 6 Reed Prentice Engine Lathe.
16 x6 Cunn Lathe, D.B.G.
16 x 7 Oliver Tool Room Lathe, Q.C.G. (new).
16 x 8 Rockford Lathe, S.Q.C.G.
17 x 10 LeBlond H.D.D.B.G. (new).
18x6 Putnam Q.C.G. Lathe.
18x7 Chard S.Q.C.G. Very good.
18x8 Rahn & Larmon, Q.C.G. Lathe.
20 x8 Hamilton Lathe, S.Q.C.G.
20 x8 Cisco Q.C.G. Lathe.
20 x8 Monarch Lathe, Q.C.G.
20 x10 Walcott Q.C.G. Lathe.
22 x10 Cisco Q.C.G. Lathe.
24 x 12 Bradford Q.C.G. c/s.
26 x 10 American with Turrets.
26x14 Bridgeford, H.D.Q.C.G.
28 x 10 Pond Engine Lathe Q.C.G.
52" Niles Tire Lathe.
Fifield Lathes 50" to 96" swing any length bed (manufactured by the Wright Works, Chicago).

BORING MILLS

2½" Niles Boring.
4" Newark Boring.
48" Bullard Vert.
60" Niles Vert.
60" Bullard Vert.
60" Colburn Vert.
14' Niles Vert.

We Buy Complete Plants

CUT-OFF MACHINES

⅞" Cap. Nat. Acme Bolt Cutter.
1¼" Cap. Nat. Acme Dbl. Head Bolt Cutter.
3" Cap. Nat. Acme Bolt Cutter.
3" Cap. Bignal-Keeler Pipe Machine.
3" Cap. Hurlbut-Rogers Cut-off Machine.
6" Cap. Davis Cut-off Machine.

DRILLING MACHINES

24" Aurora, B.G.P.F., S.H. Tap. Attach.
25" Barnes, B.G.P.F., S.H.
26" Barnes, B.G.P.F., S. Head.
32" Barnes, B.G.P.F., S. Head.
34" Barnes, B.G.P.F., S. Head.
36" Mechanics, B.G.P.F., S. Head.
42" Cinn. B.G.P.F., S. Head.
2½" Carlton Radial Drills Tap. Attach.
3' Bickford Radial Drills Tap. Attach.
3' Morris Radial Drills Tap. Attach.
4' Fosdick Radial Drills Tap. Attach.
4' Bickford Radial Drills Tap. Attach.
5' American Full Radial Drill.
10 Spdl. Natco ⅛" Cap. Multiple.
12 Spdl., Prat & Whitney Multiple.
D-4 Colburn Drills.
D-8 Colburn Drills.

GRINDERS

26" Diamond Disc Grinder.
No. 1 LaSalle Surface Grinder.
6 x 20 Fitchburg Plain Grinder.
10 x 20 Landis Plain Grinder.
8 x30 Modern Self-cont. Grinder.
12 x 30 Fitchburg Grinder.
12 x 36 Fitchburg Plain Grinder.
12 x 60 Modern Plain Grinder.
18 x 96 B. & S. Plain Grinder.
20 x 96 Landis Plain Grinder.

MILLERS

No. 2 Carter & Hakes Hand Miller.
No. 3½ Fox Hand Miller.
No. 12 B. & S. Mfg. Miller.
No. 25 Bilton Miller.
No. 3 LeBlond Plain Miller.
No. 3 K. & T. Plain Miller.
No. 3 Hendey Plain Miller.
No. 4 LeBlond Plain Miller.
No. 1½ Rockford Universal Miller.
No. 3 Owen Universal Miller.
No. 3 B. & S. Universal Miller.
No. 4 B. Becker Vert, Miller.

PUNCH PRESSES

No. 1 Toledo O.B.I. Press.
No. 3 Sidney O.B.I. Press.
No. 16 Bliss Horning Press.
No. 12 Rock River, P & S ⅝" cap.
48" Gang wheel tire punch ¾" cap.
2" Single End Punch, L. & A. No. A.

SHAPERS

16" Steptoe Crank Shaper.
20" Queen City Crank Shaper.
24" Queen City Crank Shaper.
24" Ohio Crank Shaper.

MISCELLANEOUS

Rockford Production Lathe.
¾" B. & S. Auto Screw Machine.
¾" Chicago Auto Screw Machine.
No. 0 LaPointe Broaching Machine.
No. 1 LaPointe Broaching Machine.
No. 2 Moore Screw Press.
No. 201 David Bell Hammer.
160 lb. Drop Hammer.
3" Acme Heading & Forging Machine.
500 lb. N.B.P.S.F. Steam Hammer.
1½" Acme Upsetting Machine.
Complete stock of compressors.

What Have You to Sell?

DAVID A. WRIGHT, 568 West Washington Boulevard CHICAGO, ILL.



One Shepard Elec. Crane & Hoist Co. 10-ton Standard Elec. Traveling 37 ft. 8 in. Span, 2 part double hoisting rope, Maximum lift 27 ft. Main hoist only, one 220 V. D. C. Motor. Location: Shepard Elec. Crane & Hoist Co., Montour Falls, N. Y.

One Shepard Elec. Crane & Hoist Co. 15-ton Standard Elec. Traveling 37 ft. 8 in. Span. 2 part double hoisting rope, Maximum lift 27 ft. Main hoist only, one 220 V. D. C. Motor. Location: Shepard Elec. Crane & Hoist Co., Montour Falls, N. Y.

HYDRAULIC PRESS

One General Electric Co. 1300-ton Hydraulic Cartridge Case Headings. Location: Rome Mfg. Co., Rome, N. Y.

The above equipment is offered for sale by negotiation by the Rochester District of the Ordnance Salvage Board, 1044 University Ave., Rochester, N. Y. Complete information may be obtained from the Chairman of the District at the address given above. Proposals to purchase should be similarly addressed. Directions for the purchase of these cranes and presses, as well as description of other machinery and industrial equipment, is contained in the Bulletin of the Rochester District, which will be sent upon request.

WAR DEPARTMENT

Ordnance Salvage Board
Surplus Property Sales
Get the District Bulletins

Rochester District
1044 University Avenue
Rochester, New York

An Unusual Lot of Tools of the Better Kind

List of exceptional equipment which is in first-class condition and *ready for immediate delivery*

LOCATED AT WATERTOWN, N. Y.

LARGE TOLEDO PRESSES, including:

1—59¼ double geared straight column, stroke 8-in.; weight approx. 70,000 lbs.
4—No. 59 double geared straight column; stroke 12-in.; weight, each, approx. 50,000 lbs.
1—No. 58 double geared straight column; stroke 14-in; weight, each, approx. 33,000 lbs.
3—No. 57 double geared straight column; stroke 18-in.; weight, each, approx. 20,000 lbs.
4—No. 666 Knuckle-Joint Embossing; stroke 2¼-in.; weight, each, approx. 80,000 lbs.
6—No. 857 geared Rack and Pinion Reducing; weight, each, approx. 22,000 lbs.

LOCATED AT OUR WAREHOUSE IN NEW YORK CITY

VERTICAL BORING MILLS

1—84-in. Gisholt, 2 heads on rail, single pulley drive, NEW.
1—84-in. Gisholt, 2 heads on rail, single pulley drive,
1—60-in. Niles, 2 heads on rail, cone pulley drive.
2—42-in. Baush, 2 heads on rail.
1—36-in. Bullard Vertical Turret Lathe with side head, rapid production type.

HORIZONTAL BORING MILLS

1—No. 31 Lucas single pulley drive.
1—No. 2 Rockford boring and drilling machine, motor drive, direct current motor.
2—Bement-Niles.

PLANERS: All latest type and design:

1—48 x 48 x 30 Putnam, 4 heads.
3—26 x 26 x 10 Putnam, 2 heads, NEW.
6—26 x 26 x 8 Putnam, 2 heads, NEW.
1—30 x 30 x 8 Powell, 2 heads.
1—36 x 36 x 12 Gray, 2 heads.
1—24 x 24 x 6 Gray, 1 head.
1—30 x 30 x 10 Flather, 1 head.
1—36 x 36 x 14 Ohio, 4 heads, heavy duty motor driven. Set up but never used.

MILLING MACHINES

1—No. 3 Kempsmith, plain.
1—No. 2-A Fox Universal, NEW.
1—No. 2 LeBlond heavy duty, plain.
40—No. 6 Whitney hand.
30—Stand Hand Power Feed.
8—No. 10 Pratt & Whitney hand.
8—No. 0 Bristol hand.
10—No. 3½ Fox hand.
6—4-in. Pratt & Whitney spline.
8—2-in. Pratt & Whitney spline.

DRILLS

2—Henry & Wright single spindle high speed.
1—25-in. Silver back geared, NEW.
1—28-in. Cincinnati with tapping attachment.
1—24 in. Prentice.
6—Moline Hole Hogs.
1—34-in. Prentice, back geared.
10—Single spindle Allen high speed ball bearing.
12—2-Spindle Allen high speed ball bearing.
14—3-Spindle Allen high speed ball bearing.
20—4-Spindle Allen high speed ball bearing.
11—5-Spindle Allen high speed ball bearing.
15—6-Spindle Allen high speed ball bearing.
2—3-Spindle Avey heavy duty high speed ball bearing—one with tapping attachment—NEW.

GEAR CUTTERS

1—48-in. Cincinnati.
1—36-in. Cincinnati.
1—36-in. Brown & Sharpe.
1—No. 4 Farwell gear hobber.
2—8-in. Hercules gear hobbers, NEW.

RADIAL DRILLS

4—6-ft. Baush, cone pulley drive, NEW.
1—6-ft. Reed-Prentice, motor-driven single pulley drive.
1—3-ft. Fosdick, cone drive.

GRINDERS

1—10 x 96 Norton plain.
7—10 x 36 Norton plain.
2—10 x 36 Modern plain.
2—10 x 30 Modern plain.
1—No. 11 Brown & Sharpe plain.
5—6 x 32 Norton plain.
1—No. 2 Brown & Sharpe universal.
1—No. 2 Modern universal.
1—No. 1 Landis universal.
1—No. 1 Fraser universal.
2—No. 1½ Walker Surface with magnetic chuck.
1—La Salle Surface with magnetic chuck.
2—No. 70 Heald.
70—No. 1 Blount Bench Grinders.
2—Brown & Sharpe Surface with magnetic chuck—NEW.
12—No. 20 Bryant Chucking—NEW.

LATHES:

1—42 x 17 Pond.
6—24 x 12 Boye & Emmes quick change gear.
4—22 x 12 Greaves Klusman quick change gear.
1—25 x 10 LeBlond quick change gear.
1—20 x 12 Prentice single pulley drive, geared head.
1—18 x 6 Reed quick change gear.
4—18 x 8 Rockford Economy quick change gear.
6—16 x 6 Oliver with pan and pump, quick change gear.
3—12 x 5 Hercules.
6—3½ x 60 Lo-Swing.
2—8 x 84 Lo-Swing.
20—Sidney medium pattern quick change gear Lathes with 6-ft. to 12-ft. beds and 14-in. to 20-in. swings, NEW.

TURRET LATHES

4—No. 2 Southworth screw machines.
3—Greenlee turret lathes.
1—No. 4 Warner & Swasey screw machine.
7—No. 4 Brown & Sharpe screw machines.
1—No. 12½ Garvin screw machine, fully equipped.
1—No. 3 Foster, geared head, single pulley drive, fully equipped.
1—No. 5 Foster geared head, single pulley drive, fully equipped.
8—Wood Tilted Turret Lathes, 1½-in. capacity.
10—No. 6-A Potter & Johnson, latest type.
5—No. 0 Foster.
2—No. 2 Warner & Swasey screw machines.
15—No. 1-B Foster Universal Turret.

POWER PRESSES

35—No. 16 Bliss horning.
5—No. 20 Bliss inclinable.
15—No. ¾ Toledo Bench.
1—No. 20-C Bliss with dial feed.
4—No. 42 Toledo horning.
1—No. 4 Adriance inclinable.
3—No. 14-A Stoll inclinable.
3—No. 2½ Chambersburg straight side trimming.

MISCELLANEOUS

2—No. 52 National Acme Automatics.
1—No. 54 National Acme automatic motor driven.
1—Rheinecke Relieving Machine.
1—Flather Relieving Machine.
1—Becker Backing-Off Machine.
4—No. 0 LaPointe Broaching Machines.
3—No. 1 LaPointe Broaching Machines.
2—No. 2 LaPointe Broaching Machines.
6—No. 80-B Grant Riveters.

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3—21″ x 10′ Heavy Duty LeBlond Quick Change Lathes. Each $1150.00.

1—26″ x 10′ Heavy Duty LeBlond Quick Change Lathe. $1350.00.

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5 spindle Allen B.B. Drill Press.
30″ x 30″ x 6′ Pond Planer, one head.
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2¼″ Gridley single spindle Automatic Screw Machine.
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18″ x 10′ Bradford Heavy Pattern Lathe, 3 step cone, double back gears.
32″ x 18′ Bradford lathe, c.r.
No. 0 Foster Screw Machine.
No. 1 Foster Screw Machine.
No. 1 Pratt & Whitney Screw Machine.
No. 3 Becker Vertical Milling Machine.

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For Immediate Delivery

LATHES

12x5 Vernon Q.C.G.
12x5 F.E. Reed.
14x6 Rockford Q.C.G.
14x6 Vernon Q.C.G.
15x6 So. Bend.
16x8 Sidney Q.C.G.
18x8 Prentice Bros.
20x10 Sidney Q.C.G.
25x14 Sidney Q.C.G.

BORING MILLS

No. 1 Beaman & Smith Horizontal Boring Mill, 3-inch spindle.
No. 1 Cleveland Horizontal Boring, Milling and Drilling Machine.
51″ Bertram Vert. Boring and turning Mill, two swivel heads.

SCREW MACHINES

No. 12 Garvin G.F.H.
No. 4 Warner & Swasey type G.F.H. 1¼″ capacity.
2x24 Jones & Lamson flat turret, bar work.
20″ Reed Chucking lathe.
21″ Gisholt turret.

DRILLS

1 spindle Taylor & Fenn.
3 spindle Henry & Wright.
4 spindle Allen b.b.
4 spindle Reed-Prentice b.b.
4 spindle Rockford.
6 spindle Taylor & Fenn.
22½″ Barnes b.g.p.f.
24″ Aurora Sliding Head.
36″ Foote Burt Heavy Duty.
3′ Taylor & Fenn Sensitive Radial.
4′ Fosdick Plain Radial.

GRINDERS

No. 1 Greenfield Cutter and Reamer.
Cleveland Profile Grinder.
No. 6 Bryant Hole Grinder.
10x72 Brown & Sharpe Plain Grinder.
18x120 Norton Plain Grinder.
No. 2 Brown & Sharpe Universal Grinder.

MILLING MACHINES

Becker Heavy Hand.
Bickford Hand P.F.
10x28 Bristol Vertical.
No. 13 Garvin B.G.
No. 4 Hendey Lincoln.
Thurston Die.

MISCELLANEOUS

100 lb., 150 lb., 200 lb., Standard Plain Drop Hammers.
No. 5 Stiles Pattern Bliss Press.
No. 12 Bliss Hand Screw Press.
No. 5A Standard Power Press S.A.
14x16″ Farrel Foundry Rolling Mill.

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PROVIDENCE, R. I.

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Four Model "CS" Becker Vertical Milling Machines

with circular table for continuous operation, constant speed drive and oil pump.

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TOLEDO OHIO, U. S. A.

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Machine Tool Equipment

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Engine and Turret Lathes,
Horizontal and Vertical Boring Mills,
Horizontal and Vertical Milling Machines,
Planers,
Radial, Upright and Multiple Drills,
Tool, Cylindrical, Surface and Disc Grinders,
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Pattern Shop Equipment **Forge Shop Equipment**

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DAYTON **OHIO, U. S. A.**

DRILLS, RADIALS

1—5-ft. Universal Radial Drill.
1—4-ft. Universal Radial Drill, arranged motor drive.
2—25-in Weigle Drills. S.H.B.G. P.F.
4—Hoefer Drills, 21, 24, 26, 28-in.

GRINDERS

1—10 x 36-in. Thompson Full Universal
1—No. 2-A Landis 16 x 32-in. Universal.
1—No. 2 Manhattan Suface Grinder; new.
1—Grand Rapids Drill Grinder, ½ to 2½-in. cap.
1—No. 2 Oakley Universal Cutter and Tool Grinder.
1—Greenfield Universal Cutter and Tool Grinder.
1—Wells Cutter and Tool Grinder.
1—No Ja Yankee Drill Grinder.
1—60 Heald Internal Cyl. Grinder.

SHAPERS

2—16-in. Streine B. G. Shapers; new.
3—16-in. Whipp S. G. Crank Shapers; new.
2—20-in. Ohio B. G. Crank Shapers; new.
1—Each 16, 18, 21, 24-in. Hollingsworth B. G. Crank Shapers; new.

MILLERS

1—No. 2 American Plain Mill; used.
1—Each Nos. 2-B and 2 Rockford Universal Mills; new.
1—No. O Bickett Vertical Mill and Profiler; new.
2—No. 1 U. S. Hand Millers.
10—No. 25 Becker Plain Millers.
10—No. 32 Kempsmith Lincoln type Millers.

PRESSES AND PUNCHES

3—No. 2 Pratt & Whitney Trimming Press.
1—Willard Presses 2, 3, 4, 5-A Inc.
1—62-in. Badger Combined Stake Riveter and Punch; Dia. of stake 14-in.; riveting cap. ¾-in.; punching cap. ⅝-in. x ½-in.; good as new.
1—Doty Combined Punch and Shear—Geared; Cap. about ¾ x ¾-in.; with 7-in. throat.

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Money back if not satisfied

GISHOLT TURRET LATHES

19—24-in. Gisholt Turret Lathes with 2½-in., 4¼ in. and 6¾-in. hollow spindles; chucking equipment. quick return, rapid traverse.

STEINLE TURRET LATHE

1—24-in. Steinle Turret Lathe, full swing side carriage. 4¼-in. hollow spindle, geared head, with single pulley drive arranged for motor or C-S drive.

HAND SCREW MACHINES

15—No. 2 Smith Hand Screw Machines, round collet, capacity 1 1/16-in. wire feed and auto. chuck, independent stops to turret.

BAUSH DRILLS

1—Baush Multiple Spindle Drill, arranged for 24 spindles, now with 12 spindles; takes 60-in. between colums, drills in any circle 12-48-in. diam.; approximate weight 30,000 lb.
1—No. 1 Baush High Speed Multiple Spindle Drill, rectangular head 16 x 20-in., arranged for 16 spindles, now with 10¼-in. spindles, No. 2 M. T.; cone drive.
1—No. 1 Baush High Speed Multiple Spindle Drill, equipped with round head 13½-in., with 8 1¼-in. spindles, No. 2 M.T.; cone drive.

BENDING ROLL

1—10-ft. Bertsch Pyramid Type Bending Roll, capacity ½-in. plate, drop end housing 9-in. olls.

LATHES

1—25-in. x 8-ft. Economy Heavy Duty Single Purpose Lathe, D.B.G. 3-step cone, C.R., Hol. sp., quick change feed.
1—Each Sidney Medium Pattern Lathes, 14, 16, 18, 20-in. by 6, 8, 10, 14-ft. beds; D.B.G. 3-step cone. Q.C.G.
1 each Sidney Heavy Duty Lathes 15, 17, 19, 25, 27-in long by 6, 8, 10 12, 14-ft. beds; D.B.G. 3-step cone. Q.C.G.
1—14-in. x 6 ft. Flather Engine Lathe, screw cutting. S.B.G. cone.
2—12 and 14-in. x 6-ft. Wooster Tool Room Lathe, taper attachment, pan and collet.
2—Used 18-in. x 10-ft. Hamilton Lathes, complete C.R., H.S. quick change and semi-quick change gears, countershaft, tail stock, equipped with turret.
1—32-in. x 16-in. Ohl Engine Lathe; with 4-in. raising blocks to swing 40-in., D.B.G., 5-step cone, 4-in. belt C.R.
1—20-in. x 12-ft. Engine Lathe, C.R. H.S., with Hex turret on way.
1—20-in. x 10-ft. Lodge & Davis C.R. H.S.
1—17-in. by 8-ft. Cincinnati—not screw cutting H.S., plain rest.
1—16-in. x 6-ft. Lodge & Davis—solid spindle, plain rest.

PLANERS

1—24 x 24 x 6 Gray Planer, single head.
1—26 x 24 x 8 Pond Planer, two heads.
1—40 x 40 x10-ft. New Haven, single head.

MISCELLANEOUS

1—No. 6 Quickwork Rotary Shear 48-in. th., 1-in. cap.
1—26-in. B. & S. No. 3 Gear Cutter.
1—40-lb. Bradley Cushion Helve Hammer.
1—250-lb. Little Giant Power Hammer.
1—Crank Drop Hammer, about 500-lb. cap.
1—45-in. Champion No. 8 Cupola Blower.
2—10-ton 40-ft. span, 3-motor, 3-phase, 60-cycle, 220-volt, traveling cranes.

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Good Machine Tools in Stock at Cleveland

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2—25" B. G. P. F. W. F. & J. Barnes.
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1—6-Spindle Nat. Acme Automatic Horizontal.
2—4-Spindle 12 x 34 Segourney.
2—2-Spindle Segourney.
5 Single Spindle Segourney.

AUTOMATICS & SCREW MACHINES

1—5-A Potter-Johnston Automatic Chucking Machine.
2—1¾" 4-Spindle Gridley.
8—3¼" Single Spindle Cleveland Model "A."
6 No. 1 Plain Foster Hand Screw Machine.
4—3 x 36" J. & L. turret lathe.
1—3 x 36" Jones & Lamson turret lathe two spindles.
5—2" x 24" Jones & Lamson turret lathe.
10 No. 2 Bardons & Oliver turret lathe.
4 No. 1 Pratt & Whitney turret lathe.
3 No. 2 Pratt & Whitney turret lathe.

LATHES

14—16" x 8 and 14" x 6' Monarch G. H. D. B. G. Q. C. G. and 3-step Cone—like new.
6—12" x 5' Reed Q. C. G. D. B. G.
6—12" x 5' Worcester Q. C. G.—used two months.
15—14" x 6' Blaisdell Loose C. G. R. & F. Tool Post—cheap.
6—6" x 36" Flather Tool Room Type on legs.
1—11" x 6' Cincinnati D. B. G.—Q. C. G.

MISCELLANEOUS

1 No. 6 Rivet Grinder.
1 No. 1 Lapointe M.T. Co. Broaching Machine.
1 No. 3 B. J. M. Lapointe Broaching Machine with Support.
1 No. 1½ Kearney & Trecker Plain Miller, Vertical Attachment.
1 No. 3 Pratt & Whitney Die Sinking Machine.
1 No. 2 Blake & Johnson Grinder.
1 No. 4 Industrial Knee Type Plain Miller.
1 No. 2-Y B. & S. Plain Milling Machines.
2—4-Spindle Foot Burt H. D. Drill Presses—4 fixed spindles on head.
1—No. 4 B. & O. Screw Machine, Power Feed on Turret, Drawing in Attachment, 22 Collets.
1 No. 5 Acme Power Feed on Turret and Air Chuck.
2 No. 310 Baker Drills.
1 No. 28 Aurora Drill, Sliding Head.
3 No. 1 Norton Tool Grinders (Univ.) used 2 mos.
1—12" Smith-Mills Shaper.
1—12" Lucas Shaper.
1 No. 6 Becker Vertical with Rotary Table.
1 Model "C" Becker Vertical G. H. S. P. Drive.
1—24" x 24" x 5' Gray Planer, one head.
1—24" x 24" x 6' Ames Planer, one head.
1 No. 1-A Gorton Engraving Machine, never been used.

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No. 2½ Kempsmith Plain.....$ 800.00
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No. 1 Milwaukee.....
20x7x17 Osterlein, NEW, no heads.....650.00

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12x5 Hendey quick change.....800.00
13x6 Pratt & Whitney.....175 00
Two 14x6 Davis quick change.....575.00
14x6 Lodge & Shipley.....590 00
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20"x15' Rahn-Carpenter.....1250.00
25"x18' Lowell.....650.00
8—26x14 Bridgeford D. B. G., Q. C. G. Engine Lathes
2—26x16 Bridgeford D. B. G., Q. C. G. Engine Lathes
1—26x18 Bridgeford D. B. G., Q. C. G. Engine Lathes
8—28x10 Pond D. B. G., Q. C. G. Engine Lathes.
3—28x12 Pond D. B. G., Q. C. G. Engine Lathes.
28x13 Niles-Bement-Pond.....1500.00
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1—EG52 Ferracute Embossing ¾" stroke.....1200.00
2—No. 101 V. & O. dial feed, 5" stroke, each.....600.00
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SCREW MACHINES & TURRET LATHES

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MISCELLANEOUS

Vertical and Horizontal Boring Mills 850.00 and 1750.00
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4¾"x4¾" Clayton 2-cyl. Vert. Air Compressor.....175.00

J. L. LUCAS & SON, Inc., No. 3 Fox St., Bridgeport, Conn.
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The following second-hand machinery—all in working condition—prices and detailed information on request:

1—8" Bore x 24" stroke, single, Pittsburgh Steam Hammer, 600 lb. drop.
1—Westinghouse Type SK 60 direct current, 15 H.P. 220 volt, 1700 R.P.M., Shunt Wound Motor, complete with starter.
1—Buffalo No. 6 blower, 12" outlet pipe.
1—Buffalo No. 10 blower, 21" outlet pipe.
1—Birmingham 16"x30" 2 roll rubber mill with end caps, gears 56"x8", cast iron guides 2½" pitch spur gear, 12" pinion, with safety throw out jaw clutch and one extra cracker roll.
1—Taylor Stiles Rubber Tire Stock Cutter, Style No. 2 with 12" counter shaft.
1—No. 2 Rotary Ball & Jewel Cutter.
1—Casing Bead Cutter, gear drive.
1—F. W. Clark 6" Tubing Machine.
1—Deming, Triplex Pump, size 5½x8.
1—Biggs 4'x6' horizontal rotary devulcanizer less motor, with gear drive and asbestos covering.

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NEW CASTLE RUBBER CO.
NEW CASTLE PA.

6" PIPE MACHINE

FOR SALE. 1 D. Saunders Pipe Threading Machine. Cuts 1" to 6" pipe. Complete with countershaft, threading dies, pump and tank. 95% new.

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1—24" Detrick & Harvey open side Planer with 7½' table single head and cross rail.

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CLEVELAND

FOR SALE

One No. 1 Landis Internal Grinder

Practically new. Has never been in production.

TROY FOUNDRY & MACHINE CO., Troy, N. Y.

Fully Guaranteed Machine Tool Bargains:

1—No. 1 Lucas Boring Mill.
1—14"—4 spindle Guarantee Drill.
1—28" Barnes Back Geared Sliding Head Drill.
2—24" Barnes Vertical Drill Presses, B. G.
1—2 spindle 20" Barnes All Geared Drill Press.
3—No. 25—Foot Burt 24" Drills.
2—No. 2 D Colburn Drills.
1—No. 12 Modern Grinder.
1—36" Fellows Gear Shaper.
1—No. 17 Besly Disc Grinder.
1—No. 3 Brown & Sharpe Heavy Gear Cutter.
1—No. 13 Brown & Sharpe Spur & Bevel Gear Cutter.
2—6 x 32 Norton Grinders.
1—6" Gleason Automatic Gear Generator.
1—3 spindle Gould & Eberhardt Gear Rougher.
1—22 x 10 ft. Lodge & Shipley Lathe.
1—30 x 14 ft. Boye & Emmes Engine Lathe.
1—A. B. Becker Vertical Milling Machine.
1—No. 3 Kempsmith Universal Milling Machine.
1—24" x 8 Hall Brown Woodworking Planer.
9—3¼" Gridley Single Spindle Automatics.
3—2¼ Gridley Four Spindle Automatics.
2—2¼" Cleveland—5 hole turret Screw Machines.
1—⅝" Cleveland 5 hole Turret Automatic.
1—2⅝" Gridley 4 spindle Automatic.
1—Federal Butt Welder.
2—Thompson Butt Welders.

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One Extrusion Press

Capacity 1,600 to 2,000 tons. Will handle a billet 7" in diameter and up to 30" long. Machine can be furnished with a complete set of operating valves, with connecting piping, low pressure prefilling tank, shock and relief valves. Address

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BORING MILLS
30" Warner Swasey Vertical.
36" and 60" Niles Vert. 2 hd.
42" and 50" Bullard Vert., 2 hd.
48" Colburn Vert., 2 hd.

DRILL PRESSES
20" Silver Drills, Plain & Bk. Gd.
20" Foote-Burt Mfrs. Drill.
24" Prentice, B.G.
40" New Haven, B.G.
40" Prentice, B.G.
Garvin 4-Spindle Drill, No. 3 Taper.
3' Baush Radial.
3' Prentice Radial, Tap. Att.
5' Dreses, Radial, M.D.

PRESSES
Bliss No. 76½ Str. Side, D.G., 11" stroke.
No. 30 Perkins Inclinable.
No. 56 Double Housing Power Press.

PUNCHES—SHEARS
No. 3-A Royersford SE Punch and Shear.
Long-Abstatter Type A.
Sgl. End Punch or Shear, shear 9" x 1" flat.
No. 6 Long-Alstatter DE Punch & Shear.
Reade 50" Th. S.E. Punch & Shear.
Rees 18" Sgl. End Punch.
Young Power Punch, cap. ¼" x 3/16".
Rees 18" Sgl. End Shear.
Mesta Plate Shear, Cap. ¾" x 156".
Garrison Plate Shear, Cap. ⅞" x 81", M.D.

LATHES—MILLERS
48" x 28' Niles, C.R.
36" x 18' 8" Niles, C.R.
28" x 12' Boye-Emmes q.c.g., d.b.g.
27" x 12' Pittsburgh, D.B.G.
26" x 20'6" Putnam, B.G., C.R.
26" x 10' 6" Walcott, Q.C.G.
24" x 16' 6" Johnson, C.R.
24" x 12' Ames, B.G.
22" x 12' Greaves & Klusman, q.c.g.
19" x 10' LeBlond M.D., 220 V., D.C.
14" x 6' Hendey, q.c.g.
24" x 6' Gisholt Turret, 6¼", H.S.
22" x 8' 6" Bullard Turret.
Becker No. 6 Vertical Miller.
Cleveland Nos. 3 and 2 Universal.
LeBlond No. 2 Universal.
LeBlond No. 2½ and No. 3 Plain.

PLANERS—SHAPERS
72" x 56" x 12' Betts Planer, 2 hds.
60" x 60" x 10' Bement Miles Planer, 4 hd.
30" x 30" x 10' Flather, Planer, 1 hd.
16" Lodge & Davis Shaper.
24" Cincinnati B.G. Shaper, M.D.
26" G. & E. Crank Shapers.
26" Smith Silk Rack Shaper.

MISCELLANEOUS
Binssee Hor. Boring Mch. 3" bar.
Bement-Miles Boring, Drilling & Milling Mch. M.D., 6½" dia. bar.
Plymouth Grinders Nos. 13-14-17-20-23.
Greenfield Un. Cutter & Tool Grinder.
Williams White No. 1 Bulldozer.
Bement 1500 lb. Steam Hammer.
Niles 15" Slotter.
Cleveland Straightening.
Rolls, 84" x 10" dia.

Botwinik Bros.

Specials F. O. B.

New Haven

1—No. ½ LeBlonde Universal Miller complete, excellent condition $1000.00
5 Southbend 16"x8' Engine Lathes Complete like new....400.00 ea.
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40 Becker No. 7-H Lincoln Millers 95% good ..... 250.00 ea.
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50 ton 1 15/16 Cold Rolled Steel Shafting 90% new, 2000 lb. lots .....06 per lb.
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2000 new and slightly used American Split Pulleys, 25% off list.
20 ton 1st grade used belting, all sizes at $.10 cents for 1 ft. x 1" x single ply.

Terms 25% with order, balance sight draft with bill of lading.

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New Haven **Conn.**

ON OUR FLOOR

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1—No. 3 Brown & Sharpe Universal, complete.
1—No. 7-H Becker Lincoln Type.

SHAPERS
1—24" Cincinnati back geared, with vise and Countershaft.
1—24" Queens City back geared, with vise and Countershaft.

LATHES
1—30" x 10' Pond Engine Lathe, massive pattern.
1—26" x 18' Niles Bement Pond, triple geared.
1—24" x 10' Pittsburg, QCG., DBG.
1—18" x 8' F.E. Reed Engine Lathe.

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278 Washington St. **Newark, N. J.**

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Phone Crescent 2744 **BUFFALO, N. Y.**

Bargains in Used Machine Tools

6—3¼" Gridley Automatics, S.S.
6—No. 56 National Acme Automatics.
6—No. 55 National Acme Automatics.
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10—20"x10' Walcott Lathes, D.B., Q.C.
5—27"x10' Bridgeport Heavy Duty, Q.C., D.B.
5—26"x12' Putnams, D.B., Q.C.
2—24" Baker Drill Presses, heavy duty.
2—No. 148 Frankford Furnaces, Oil, NEW.
2—Frankford Furnaces, oil, about 36"x20' long.
2—14"x14" Bury Air Compressors, 550 f.p.m. 80 lbs.
1—Ingersoll-Rand Air Compressor, 2 stage, 850 cu. ft. per min., 100 lbs.
1—Reihle Test Machine.

Agents for Frontier Hack Saws and Drill Presses

Send us list of machines you want or have for sale

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Inquiry Department

will help you find any special equipment not listed here—write us. There is no charge for the service—we *want* to help you.

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Machinery—For Sale

10—250 ton Southwark Hydraulic Presses.
1—200 H.P. Ideal Motor 40 cycle, 550 Volts.
3—Steel Tanks with Agitators 12' x 3' x 4' deep.
1—Goodell-Pratt Toolmakers lathe 5" swing.
1—Forbes Power Pipe Cutting and Threading Mch. 1" to 6" pipe.
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1—Sellers & Co. No. 1 Tool Grinder.

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Practically New Tools For Sale

Have Only Been in Use Six Months

1—No. 3 Owen Universal Milling Machine.
1—20" Cincinnati H.D. Back-Geared Shaper.
1—W. & M. Yankee Drill Grinder.
1—25" Weigel Sliding Head Drill.
1—14 x 6 Whitcomb-Blaisdell Lathe, Q.C.
1—Sterling Universal Cutter Grinder.
1—Robertson No. 5 High Speed Economy Hacksaw.
2—No. 7 Foster Screw Machines, complete.

Corley-DeWolfe Company

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BEVEL GEAR GENERATORS
2—16" Bilgrams. Regular equipment.
SPUR GEAR MACHINES
3—36" Fellows. Regular equipment.
1—No. 2B 24" Newark for spurs and bevels.
GRINDERS
1—No. 23 Brown & Sharpe for cylinders.
1—No. 4 Gardner Double End Ring Wheel.
1—No. 120 Gardner Combination Disc Grinder.
1—No. 2 Landis Internal.
3—20" Wet Tool Grinders.
TURRET LATHES
1—17" 2-spindle Jones & Lamson.
3—3 x 36" Jones & Lamsons. Geared feed.
2—24" Steinles. Single pulley drive.
2—No. 24 Geo. G. Prentice 4-spindle. Semi-automatics.
MILLING MACHINES
2—No. 6 Beckers. 62" table feed.
1—No. 5 Ingersoll, Combination horizontal and vertical.
1—42 x 42 x 12' Ingersoll. Slab type.
RADIAL DRILLS
1—5' Western. Heavy type, plain, triple geared.
DRILL PRESSES
1—1 x 6 Baker Bros. Vertical Automatic.
1—No. 13 D. Moline. Heavy duty.
2—8-spindle Baush Adjustable Drill Heads. Cap. 8½" circle. ⅝" drills.
1—No. 17 Foote-Burt 4-spindle, rail type.
1—No. 1½ Foote-Burt 4-spindle, rail type.
3—No. 3 30-spindle Baush Multiples.
PLANERS
1—24 x 24 Pond. Heavy duty. One hd.
BOLT CUTTERS
1—2" Landis. Single head.

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The following machinery in good condition. Selling to make room for special production machinery.

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1 only Norton Grinder 10 x 36 Universal $2,000.00
1 only Landis Grinder 12 x 32 Universal 1,000.00
1 only Engine Lathe—Perkins 14 x 6 ..... 170.00
1 only Engine Lathe—South bend 13 x 6 ..... 160.00
1 only Wood Tilted Turret Lathe—one inch 625.00
1 only Drill Press—20" Star Lever 125.00
1 only Special Lathe—Heavy duty 200.00

DELIVERY—SEPT. 1st

2 only Engine Lathes—Fulton 18 x 6 ..... $750.00 ea.
2 only Engine Lathes—Sidney 15 x 6 ..... 700.00 ea.
3 only Engine Lathes—Willard 13 x 6..... 400.00 ea.
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AMERICAN MACHINE PRODUCTS CO.
MARSHALLTON, IOWA

Used Tools—Excellent Condition

BORING MILLS
1—52" Rogers & Hemphill vertical, two heads.
GEAR CUTTERS
1—14" Lees-Bradner gear generator.
1—36" Brown & Sharpe spur gear cutter.
LATHES
1—10" x 8' Gray, l.c.g., plain rest.
1—16" x 8' Walcott & Wood, h.s., c.r.
1—16" x 6' Milwaukee, c.r., 12" chuck.
1—20" x 8' Sidney, q.c.g., c.r.
1—26" x 12' Bullard, triple geared, taper att.
BOLT CUTTERS AND PIPE MACHINES
1—1¼" National double head bolt cutter.
1—2½" x 6" Curtis power pipe machine.
TURRET LATHES AND SCREW MACHINES
1—No. 1 Pratt & Whitney ⅝" cap. hand screw machine.
1—24" Steinle heavy turret lathe, 4" h.s.
2—2¼" x 24" Jones & Lamson geared head turret lathes.
MISCELLANEOUS
1—No. 1 Stewart gas oven furnace.
1—No. 9 Stewart gas oven furnace.
1—No. 18 Stewart crucible furnace.
1—No. 3-D Minster high duty drill.
1—No. 1 Fraser universal cylindrical grinder.
1—12" x 24" Modern plain grinder.
1—Springfield univ. gauge grinder with motor.
1—No. 3 American Can inclinable power press, 2" stroke.
1—16" x 16" x 36" Hendey planer, one head.
1—No. 3 Burr cold saw.
1—No. 11½ Higley cold saw, 3" cap.
2—No. 2 Marvel saws.
1—No. 1 Racine saw with pump.
1—No. 10 Racine saw.
1—20" Ohio back geared crank shaper.
1—No. 1 Garvin tapping machine.
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18"x8' Greaves-Klusman Lathe, Q.C.G., D.B.G.
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20"x10' Lodge & Shipley Lathe, Q.C.G.
24"x12' Lodge & Shipley Lathe, Q.C.G., T.A.
24"x12' Pittsburgh Lathe, raising blocks to 34".
28"x6' Warner & Swasey Plain Turning Lathe.
48" Niles Car Wheel Lathe.
2—3"x36" J. & L. Turret Lathes, Grd. Hd., S.P.D.
2—16" Crank Shapers—New.
20" Back Geared Crank Shaper—New.
24" Gould & Eberhardt Shaper.
No. 3 Cincinnati Plain Miller.
No. 2 Kempsmith Plain Miller.
9' Baush Plain Radial.
3' Fosdick Plain Radial.
60" Bullard Vertical Boring Mill, 2 swivel heads, belt drive.
48" Colburn Vertical Boring Mill, 2 heads.
42" Bullard Vert. Boring Mill, 2 swivel heads.
42" Colburn Vert. Boring Mill, 2 swivel heads.
36" Niles Vert. Boring Mill, 2 swivel heads.
No. 4 Hilles & Jones Shear, S.E., throat 36".
Reade Single End Punch, 50" throat, 1¼" x 1¼".
Single End Punch, geared, ¾"x¾".
No. 3 Bliss Plain Double Seamer.
52" Niagara Power Squaring Shear, 14 gauge.
6'10" Bending Rolls, cap ¾" plate.
No. 86 Niagara Double Acting Cam Press, geared.
2—No. 3 Losbough-Jordan Presses, 2000 lbs., 2½" stroke—New.
No. 4 Loshbough-Jordan Press, 3500 lbs., 3" stroke—New.
No. 4—A Willard Press, 1400 lbs., 2" stroke—New.
No. 1 Draper & Hall Surface Grinder—New.
Draper & Hall Imp. Univ. Grinder—New.
Partial List. Send us your inquiries.

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WANTED
TWO ENGINE LATHES
20" x 10 or 12', complete for screw cutting, and with the ordinary attachments. Must be motor driven for 220 volt, DC current, and in good condition. Give full particulars
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WANTED: One Adriance Combination Horning and Wiring Press No. 24. Also one Bliss No. 2 Press. State price and location.

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1—Hall Air Compressor No. 5080—Major 9 x 9 x 9.
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2—No. 34 Stoll Double Seamers.
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2—No. 6 Stoll Beading Machines.
2—No. 100A Niagara Beading Machines. Ready for immediate shipment.

GILBERT & BARKER MFG. CO.
SPRINGFIELD MASS.

USED MACHINERY

Immediate Delivery

38" Bridgeport Vertical Boring Mill.
60" Betts Horiz. Boring Machine.
60" Bullard Vertical Mill.
½" Acme single Hd. Bolt Cutter.
20" Barnes All Geared Drill.
22" G & E Slid. Head Drill (6).
No. 25—24" Foote-Burt Hvy. D. Drill.
25" P & W Sliding Head Drill.
No. 3—26" B. & S. Gear Cutter.
No. 1½ Bilton Auto. Gear Miller.
10" x 26" Ott Universal Grinder.
No. 24 Landis 14" x 48" Plain Grinder.
No. 3 B & S Plain Grinder.
800-lb. Massillon Steam Hammer.
No. 2 LaPointe Broacher.
800-lb. W. W. & Co. Beard Drop Hammer.
18" x 8' Whitcomb Blaisdell Lathe, q.c.g.
18" x 10' Prentice Lathe, q.c.g.
21" x 12' Lodge & Davis Lathe.
22" x 12' Greaves-Klusman Lathe.
24" x 12' Prentice Lathe.
25" x 12' Bradford Lathe.
26" x 12' Putnam Pacific Coast type Lathe, motor driven, with motor.
32" x 24' Fay & Scott Lathe.
No. 33 Kempsmith Prod. Miller.
24" x 24" x 8' Ingersoll Slab Miller.
No. 3 B. & S. Universal Miller.
No. 2 M. P. & J. Horiz. Auto. Miller.
No. 2 V. P. & J. Vert. Auto. Miller.
32" x 32" x 8' New Haven Planer.
36" x 36" x 8' Betts Planer.
48" x 60" x 16' Betts Planer.
2" x 24" J. & L. Turret Lathe.
No. 2 Pratt & Whitney Turret Lathe.
2" x 2½" Cleveland Auto. Screw Mach.
No. 3 and 4 Foster Hand Screw Machine.
18" Niles traveling head shaper.
24" Conradson Turret Lathe.

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Gridley 4¼" Automatic Screw Machines;
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2" x 24" Jones & Lamson Turret Lathes;
Thirty-eight Hand Screw Machines: Brown & Sharpes, Warner & Swasey, Acme, Pratt & Whitney. Millholland—⅜" to 2" capacity;
Engine Lathes; various sizes;
Wisconsin Hand Milling Machines;
Springfield Mch. Tool Co. 7" x 60" Spindle and Axle Boring Lathe;
Henry & Wright Bench Drills;
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MACHINERY
all in first class condition for immediate delivery—prices on application.

Milling Machines
Profilers, Drill Presses
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Woodworking Machines

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We have a large stock of cold drawn and machinery steel in rounds and are prepared to handle orders promptly

FEDERAL SIGNAL CO.
ALBANY, N. Y.

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BORING MACHINES
2—24" Bullard vertical turret lathes, latest pattern, excellent condition.
52" Baush vertical, two swivel heads, good as new.
6 ft. Cincinnati vertical, two swivel heads.
Nicholas & Waterman horizontal cylinder, boring bar and facing machine, 6" bar.

DRILLING MACHINES
6—Moline No. 117 single spindle "hole hog," excellent condition.
14" Myers single spindle sensitive.
No. 310 Baker Bros. high speed.
4 ft. Fosdick plain radial speed box drive.
4½ ft. old style full universal radial.

ENGINE LATHES
24" x 14' Lodge & Shipley Selective geared head, with taper attach.
32" x 16' Fay & Scott, compound rest, power feed turret on shears, fine condition.
42" x 24' Davis-Egan, with compound rest, suitable for thread cutting.

MILLING MACHINES
No. 4 Cincinnati high power universal, single pulley driver heavy vert. attachment.

PLANERS
36" x 36" x 8' Niles, three heads.
36" x 36" x 10' Niles, three heads.
36" x 36" x 12' Rockford, two heads.
60" x 60" x 12' Gleason, 3 heads.

SHAPERS
16" Rockford back geared crank.
16" Steptoe back geared crank.
3-24" Walcott geared shifting belt.
3-20" Walcott geared shifting belt.

MISCELLANEOUS
5-Ton Whiting crane, 22 ft. span, 102 ft. runway.
Detroit centerless grinder, good condition.
2" Oster cutting off and reaming machine.
Garvin No. 00-S horizontal duplex tapping machine, NEW.

MARSHALL & HUSCHART MACHINERY CO.
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Immediate Delivery

AUTOMATICS AND TURRET LATHES
1—⅝" Cleveland Model A Automatic.
1—1" Cleveland Model Automatic.
2—No. 2 Pratt & Whitney Screw Machines, ⅝" wire feed.

DRILLING MACHINES
1—3½' Arm Canedy Otto Radial.
2—No. 26 16" Canedy Otto Sensitive Drills.
3—No. 36 20" Canedy Otto Back Geared Power Feed Drills.

GRINDERS
1—No. 2 Norton Universal Tool and Cutter Grinder, complete.
1—No. 2 LaSalle Automatic Surface Grinder.

HAMMERS
1—1000 lb. Williams & White Board Lift Drop Hammer.
1—1500 lb. Billings & Spencer Board Lift Drop Hammer.

LATHES
1—16"x6' Davis.
1—16"x7' Union.
2—18"x8' Greaves Klusman.
1—18"x10' Robbins.
1—26"x11' Walcott.

MILLING MACHINES
1—No. 1 Dow Plain Miller, complete.
3—No. 12 Pratt & Whitney Semi-automatic Milling Machine, complete.
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MISCELLANEOUS
2—6"x6" Peerless High Speed Hack Saws.
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2—2-ton Canton floor frames.

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15 Tons New Brass Rod 2½ Dia. Mill Length

1000 Lbs. New Brass Wire, No. 7 Stubbs Ga. in Coils.

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The most complete small shop in Baltimore, Maryland; highest class equipment, all nearly new; millers, planers, grinders, presses, turrets, gear cutters, furnaces, and abundant fixtures and small tools. Capacity for about 75 men.
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Reliable Machine Tools, New and Rebuilt

SPECIAL

50 New 16" Quick Change Lathes 6' and 8' bed.

For immediate delivery

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Hand and Small Power Millers.

Planers and Shapers

66" x 66" x 20' New Haven, 2 head.
60" x 60" x 20' Sellers, 4 head.
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48" x 48" x 16' Beament-Miles, 2 head.
44" x 44" x 12' Pond, 4 head.
36" x 36" x 18' Pond, 1 head.
22" x 22" x 6' Gray.
24" x 24" x 6' Pease.
14" Niles traveling head.
16" Rockford.

Turret Lathes and Screw Machines

1⅛" Tilted Turret Friction Back Geared.
2" x 24" and 3" x 36" J. & L. Sing, Pulley.
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National Acmes, No. 52, No. 53, No. 56, 2 x 24 and 3 x 36 J. & L.'s.

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Madison for Cylinders in Block.
Wells, Cutter & Tool, new (2).
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10" x 30" W. & P. Univ., new.
10" x 24" Landis Universal.
10" x 20" Litter Plain.

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25" x 12' LeBlond, Heavy Duty.
24" x 48" x 16' Rahn-Larmon Gap.
8" x 60" Fitchburg Low Swing.
28" x 12' Fay & Scott.
12" x 5' Geared Head (3).
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Sensitive 1, 2, 3, 4, and 6 Spindle.
24", 26" and 28" Sliding Head.
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3' Bickford Plain, Gear Box.
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No. 856 Toledo, 36" stroke, 15,000 lbs.
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Perkins Dbl. Crank 16" x 24" Bolster.

SPECIAL

Yates New Plate Grinders 36" and 66" capacity.

10 of each size

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Hammers, 40 and 50 lb. Bradley.
Hammer, Toledo 5000 lbs. Friction Board.
Gear Cutter G & E, 36".
Oil Groover, Garvin, nearly new.
Compressors 8 x 8 and 10 x 12.
75 H.P. Motor, 220 volt, 3-phase.
Plating Dynamo, 2500 Amperes.

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WANTED: No. 2 Universal Milling Machine, Brown & Sharpe, Cincinnati or Milwaukee preferred. Advise price, condition and age of machine.

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Bradford, Pa.

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3—2 x 24 J & L Turret Lathes.
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1—Small Rickert & Shafer Tapping Machine.
1—18" x 12' Lathe.
1—No. 4 Garvin Miller.
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8-20

MACHINERY'S Green Section, Date.....
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I should like particulars in regard to the following used equipment:

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Name .....

Address .....

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BRUBAKER REAMERS
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Catalog No. 6 lists our stock of standard tools. Send for it.

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Non-corrosive Steel

High silicon, chromium steel. Completely resistant to fruit and acids.

Especially adaptable for exposed surfaces which have to withstand the combined action of salt water and the atmosphere, also for cutlery and surgical instruments. When hardened it is file hard. Does not warp, crack or check.

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A high silicon chromium alloy steel, intended to be used in the soft condition. Is more rust resisting than any other metal yet produced. Can be forged with ease, and when annealed can be easily machined.

Highly resistant to acids and high pressure steam. Will not corrode or erode.

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Heat Resisting Steel

Can be heated for months up to 1800° F. without any appreciable scale forming on surface.

Very resistant to the action of acids, organic or inorganic. Particularly adaptable for resistance wire elements, carburizing boxes, automobile valves, etc.

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Non-erodable, non-corrodable and non-oxidizable. Can be heated at 2000° F. for months without any material scale forming. Particularly adapted for electrical resistance elements. Can be readily hot rolled, cold drawn and machined.

Four New Ludlum Steels

After extensive investigations we have finally produced a *silicon chromium alloy steel* which has resulted in a more non-corrosive metal than any previous records have ever shown.

This new patented alloy can be forged and rolled with ease, hardened without difficulty and annealed so that it will machine easily. It is capable of taking a very high mirror finish, and is highly resistant to the action of nitric, sulphuric, hydrochloric, acetic and fruit acids, and also to atmospheric and salt water corrosion.

This remarkable alloy combination is also extremely durable at high temperature and has a very high specific resistance.

We are now using this new alloy in the formulæ of four new Ludlum Steels described in the panel at the left.

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ESTABLISHED LUDLUM 1854

ROUILLARD 4 in 1 TOOL HOLDER

EVERY ONE INDIVIDUAL



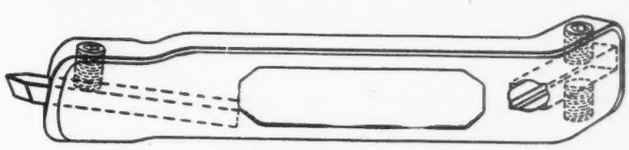
We Must Increase Factory Space to Keep Step With Sales Growth of This Remarkable Tool Holder. Study the Pictures—They Tell the Story

ROUILLARD 4 in 1 Tool Holder. Size No 3 (5/16″) cost you $7.00 where four of the usual or ordinary kind cost you from $12.00 up. Besides you save 75% in time "chasing" single holders for changes.

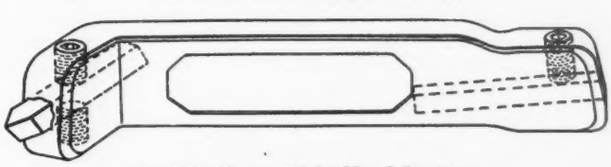
Ask for circular and our Guarantee. Better yet—send for a trial order, one will convince you.

Judge by comparison.

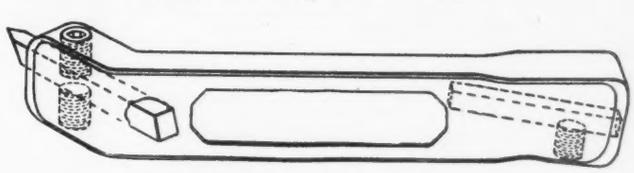
Here you see four tools in one with none of the shortcomings of the ordinary combination tool.



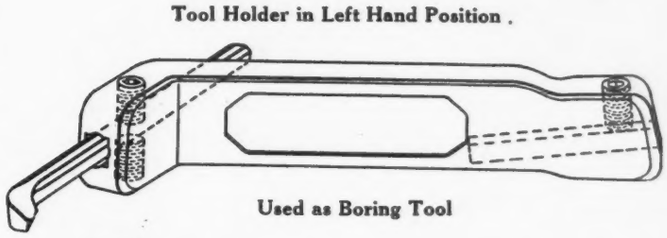
Tool Holder in Straight Position



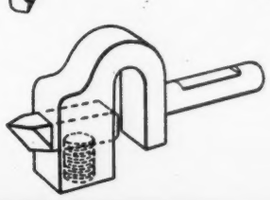
Tool Holder in Right Hand Position

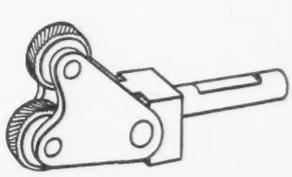


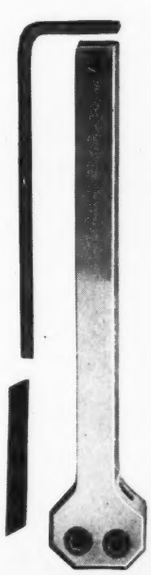
Tool Holder in Left Hand Position



Used as Boring Tool







Rouillard 3 in 1 Shaper Tool

The Rouillard Shaper or Planer Tool Holder is a big brother to the Rouillard Universal. It is made expressly for shaper and planer work—has the rake left out, and makes good the claim that

"It always stays in the machine"

Straight—Right—Left

ROUILLARD TOOL CORPORATION, Philadelphia, Penna.

608 Chestnut Street



"Cadillac" Now Uses ECONOMY Grinding Lubricant

The Cadillac Motor Car Company, Detroit, have been using Economy Grinding Lubricant on about 30 grinding machines for the past six months. The photograph shows a Norton machine finishing a high carbon steel camshaft. "Economy" Lubricant is keeping the work cool, the wheel clean and is imparting a fine polish to the shaft.

The Cadillac grinding expert finds that by using "Economy" Lubricant the polish is much finer on ground work than is the case when soda water, oil or any other lubricant is used. The trouble experienced with these materials is their readiness to fill with dirt and the consequent tendency to glaze the wheel and scratch the work.

ECONOMY
EC
OMY

Trade Mark
Reg. U. S. Pat. Office.

With "Economy" Grinding Lubricant the dirt settles to the bottom of the tank, leaving the Lubricant always clean. Is it any wonder that "Economy" Lubricant is making good in the Cadillac plant?—and these same results can be duplicated in your case by using "Economy" Grinding Lubricants in your Grinding Machines. Write us for details.

THE WHITE & BAGLEY COMPANY

WORCESTER, MASSACHUSETTS, U. S. A.

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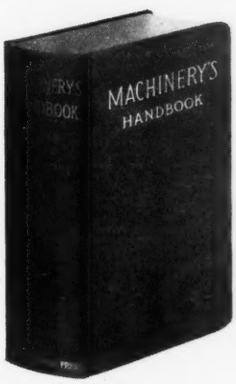


How Shall We Send Yours?

The specific data you must have in a hurry for any problem of machine shop, tool or drafting-room you will find in

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MAIN OFFICE-PEORIA, ILL.

PEORIA, ILL. June 8, 1920

The Industrial Press,
140-148 Lafayette St.,
New York City, New York.

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Will you kindly rush us by Airplane Post to Chicago and then by Special Delivery Mail to this office one copy of your MACHINERY'S HANDBOOK. Also, send us invoice at the time of sending the book and we shall pass same through for payment.

Yours truly,
AVERY COMPANY
Advertising Manager.

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TABLE OF CONTENTS

Mathematical tables, logarithms, areas, volumes, geometry, trigonometry, strength of materials, friction, bearings, cam design, spur, bevel, spiral, herringbone, epicyclic gearing, belts, pulleys, speeds, feeds, milling machine indexing, machine shop practice, tool-room practice, formulas for toolmaking, heat treatment of steel, foundry and pattern shop practice, welding, conversion tables, weights of materials, patent laws, drawing and blue printing, manufacturing shop appraisal.

"You've got the answer when you've got the Handbook"

8-20

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CUTTING THE COST OF BUYING

FOR economical production it is necessary to locate factories where the labor and facilities are.

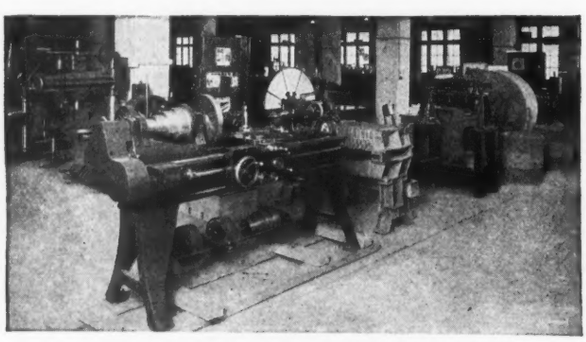
To sell economically it is necessary to send salesmen where sale possibilities abound.

To buy economically it is necessary for buyers to go where purchasing facilities exist.

The last statement applies with special force to foreign buyers. They lack the knowledge of the location of American factories or sales offices, the time to travel to them, and should not be obliged to incur the heavy expense of searching all over the United States for the goods they require.

International Exposition of Industries Reduces the High Cost of Buying

This exposition, centrally located in Grand Central Palace, in the heart of the commercial center of the world, holds under one roof the permanent exhibits and sales offices of nearly five hundred of America's leading manufacturers, with sales representatives in attendance and providing every facility for the display, demonstration and sale of products, appliances, and machinery.



BUYERS: Send for our free classified list of exhibitors and products. If contemplating a trip to New York, write or wire our Service Department to reserve hotel accomodation for you. Do not fail to visit the Exposition and see the displays of more than 450 American Manufacturers.

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Our Specialties

Cold Drawn Shafting, Screw Stock, Flats, Squares, Hexagons and Special Shapes. Finished Machine Keys including Keys for the Woodruff System, Machine Racks, Finished Crank Shafts and complete Connecting Rods.
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Standard Gauge Steel Co.

Beaver Falls Penna., U. S. A.

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Chicago, Ill. Philadelphia, Pa.

Type A.S. Adjustable Speed RELIANCE MOTORS

To Change the Speed Turn the Handwheel



Are You Using the Motor Drive That Pays?

Between ordinary motor drive and machines driven by Type AS Motors there's a vast difference in production costs.

Ten years ago in the plant where this picture was recently taken, they purchased a Reliance Type AS Motor for individually driving a boring mill. Between then and now they have applied over 200 more Type AS Motors—many of them to belt-driven machines. And the increased production, better quality and lower costs from these machines have been so evident that all new machines are now purchased motor-driven.

The Type AS Reliance Motor on this Boring Mill enables the operator by simply turning the hand wheel to change speeds instantly without current loss and the horsepower output remains the same at all speeds.

Thus, he keeps cutting speeds at top notch as work changes. Type AS Reliance Motors run at any speed over any range up to 1 to 10.

Ponder this well. How else could you so assuredly increase production and obtain so many advantages that bring a bigger return? You'll need a copy of Bulletin 1014 to settle the question right, it is yours for the asking.

RELIANCE ELECTRIC & ENGINEERING COMPANY

1056 Ivanhoe Road **Cleveland, Ohio**

BRANCHES:

Boston Pittsburgh New York Chicago Philadelphia Detroit

ORIGINATORS

Of The Ground Radial Relief Combination-center Drill and Reamer

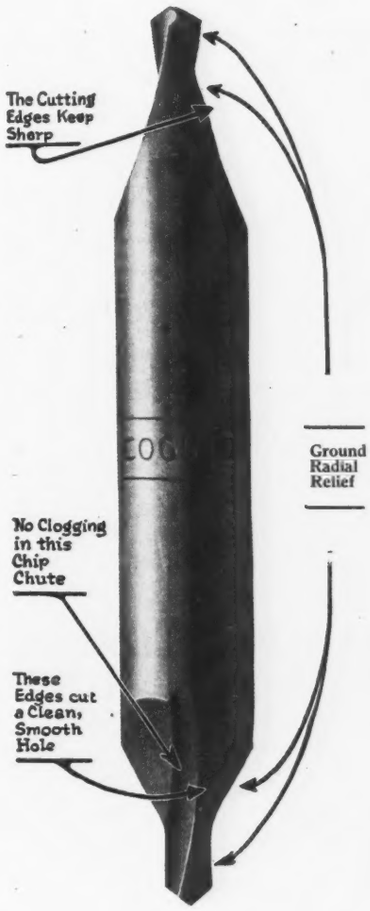
The COGS DRILL

By originators we mean exactly what we say.

We conceived the idea of grinding radial relief on the drill and countersinking portions of the center drill.

Conception with us meant action. We immediately proceeded to supply an article much in demand, therefore we believe credit will be awarded the persistent endeavor of the Cogsdill Manufacturing Co. for the ground center drill.

The Cogsdrill is the properly ground center drill. A test will conclusively demonstrate.



Cogsdill Mfg. Company

DETROIT MICHIGAN



Note the Spiral Fluted Chip Chute.

OUR CATALOG NO. 2 FOR THE ASKING



"UTILITY"

Interchangeable Counterbore and Spot Facer

Speeds Through the Scale of Cast Iron or Steel

You can drive this "Utility" counterbore through the hard scale of iron or steel castings without coaxing or babying. It cuts clean, with speed that immediately reduces production time. The high speed steel cutter is larger than the holder; it is locked firmly and driven positively. The "Utility" is rugged, built to stand constant use in manufacturing operations. It is accurate to a degree that insures its selection for toolroom work of the finest character.

Careful and exacting buyers pick the "Utility" because of its unlimited capacity. We invite you to try this tool in your own shop on your own work—to make any comparison you please. Write us today.

You Can't Twist the Pilot Off, You Can't Break the Cutter in any Ordinary Service.

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"All the Comforts of Home"—

No man minds work if there is plenty of good cold water to drink, a big bowl with running water for washing up, a private cupboard to take care of his "duds." These things keep a man cheery at his job. Try going without them yourself and see what it means.

We equip plants large and small with M. E. & E. Ice Cooled Bubbling Fountains, Individual Wash Bowls, Individual Fireproof Lockers at moderate cost. Write for estimates. Complete catalog on request.



Supplies 150 people; holds 75 lbs. ice and 15 coils 1½" seamless brass tubing; attaches to municipal water supply. Furnished with stream erect or inclined.

OUR LINES INCLUDE: Sanitary Wash Bowls, Fountains and Vault Fixtures; Metal Lockers, Storage Racks, Shelving, Cabinets and Furniture; also full line of Plumbing Material.

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Works and Mail Address: FRAMINGHAM, MASS.



New Perfection Wash Bowls in Batteries Common waste—Common water supply—Common or separate vent.

MEEco
Metal Equipment For Shop And Factory

UP-TO-DATE DRAFTING METHODS *Number 8*

The Universal Drafting Machine

Beside his T-square the old-fashioned draftsman has a scale, a couple of triangles and a protractor lying loose on his board—all with a marked tendency to lose themselves.

The Up-to-Date draftsman, on the contrary, has all these tools combined in the Universal Drafting Machine with control centered under his left thumb and *his pencil never leaves his hand* as with swift, sure strokes he sets down his idea as fast as it develops in his brain.

Old "T-square and Triangles," however, must toil through a succession of operations, laying down his pencil repeatedly to pick up first one tool and then another, constantly breaking his train of thought by the multiplicity of detail necessary to transcribe it.

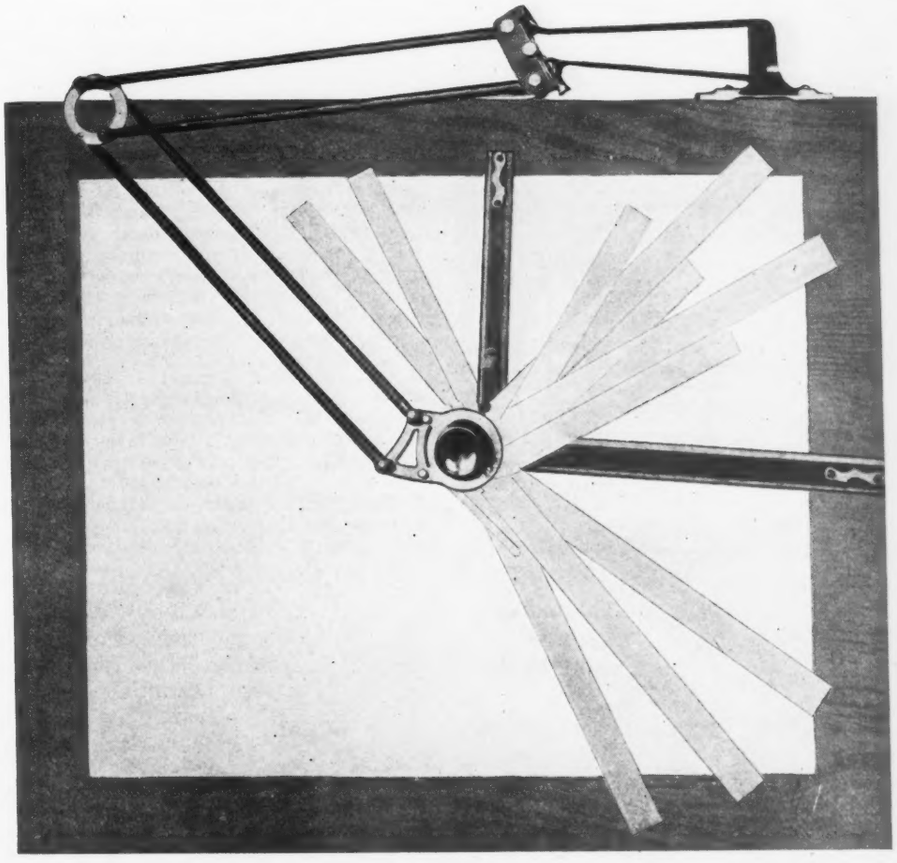


Angle Work Is a Cinch

The Universal Drafting Machine has the 30°, 45° and 60° angles instantly available without referring to graduations and the "built-in" protractor permits setting the scales quickly and accurately at any other desired angle.



Other points to superiority of the Universal Drafting Machine are fully described in our 1920 Catalog and our 30 day, free trial offer will demonstrate their application to your work.



UNIVERSAL DRAFTING MACHINE COMPANY

CLEVELAND, OHIO, U. S. A.

WOLFRAM

HIGH SPEED STEEL of SUPERQUALITY



The Devil's Gold

THERE is a legend in the Tungsten Fields of Colorado which accounts for the likeness of Tungsten to Gold. The Devil, as is well known, long ago found gold the greatest source of trouble and evil to mankind. Therefore he got possession of vast deposits of the precious metal, and for centuries amused himself by plaguing men with it. Such a quantity, indeed, he accumulated, that there soon was more gold than there were men to plague, so that half his gold lay in glittering, useless heaps.

In a fiery rage because of this, he cried, "If I can not use my gold, then no one else shall!" and he waved his spiked tail once, twice, thrice. The gleaming yellow turned dull and dark, and behold the piles of gold were transmuted into mounds of black sand. When the gold miners passed that way they scarcely cast an eye upon it, for they knew it not for what it was. And the Devil laughed because of the trick his spite had played upon them.

But one day a wise man traveling through that country came unawares upon the Devil's gold, and, sitting on the ground to rest himself, let his fingers run idly through the dark sand. "'Tis strangely heavy," murmured he, "quite like to gold in weight." And so it was, for the Devil had not changed its weight at all (there are things the Devil himself can't do). The Wiseman then looked more closely and saw that it was a substance of great worth. Rising quickly he went back to his fellow-men and told them what he had found; and from that day to this the Devil's gold has been mined without ceasing, and no quiverings of the angry Devil's tail can alter its usefulness.

Parents in the Colorado Tungsten country, they say, still tell this legend to their children as proof that the ruler of the lower regions is not all-powerful. For Tungsten, with its many valuable properties, such as its stability and its high melting point (about 5400° F.), is just as necessary to men as gold.



Send us your inquiries

It is a peculiar co-incidence that the three things from which "Wolfram" High Speed Steel is named come from Colorado in the heart of the United States—the Wolf, the Mountain Ram, and Tungsten (another name for which is Wolfram). "Wolfram" is a fitting name for this typically American High Speed Steel.

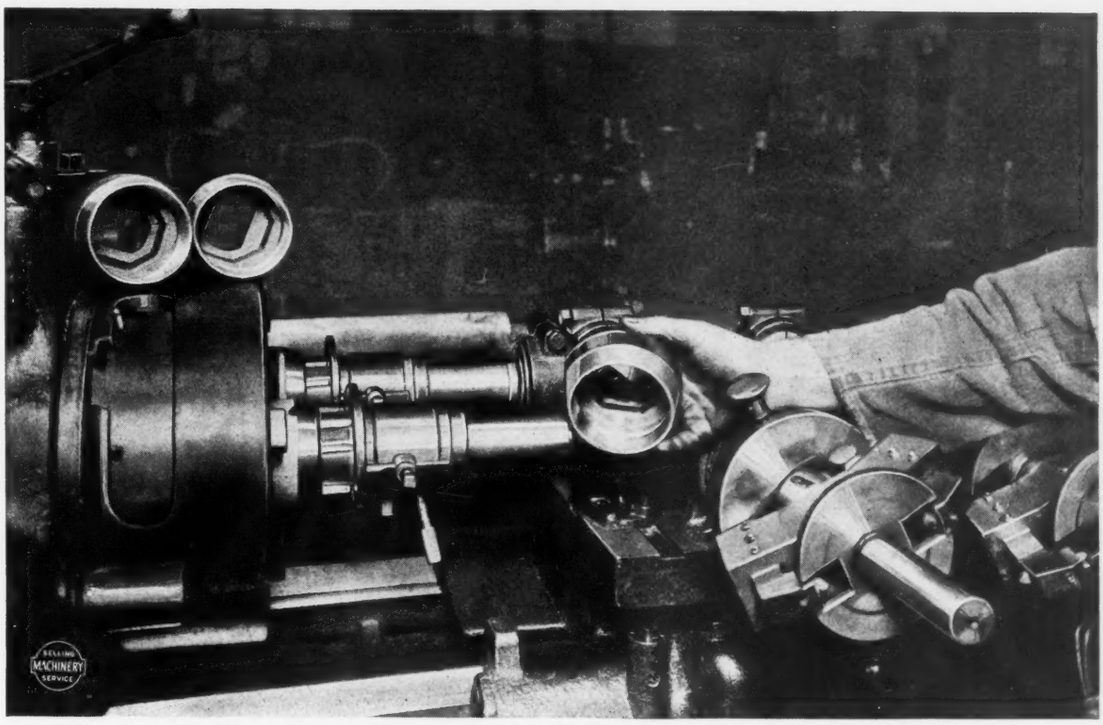
VULCAN CRUCIBLE STEEL COMPANY

Aliquippa *Established 1900* **Penna., U. S. A.**

MAKERS OF WOLFRAM HIGH SPEED STEEL

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MURCHEY TAPS



Captured this Job on Speed

The "authorities" at the American Wire Wheel Corporation's plant, Buffalo, N. Y., are always open to conviction; if there's a better way of handling an operation they are ready to be shown. In this case it was Murchey Collapsing Taps that did the talking and what they said about cutting 12-pitch threads 3⅝" diameter by 1⅛" length in brass automobile hub caps closed the discussion. Of the four operations necessary to get the hub caps ready for use, threading is the most exacting and requires the least time to perform—with Murchey Taps.

Murchery Collapsing Taps and Expanding Dies have many advantages, among others chasers that recede when the thread is cut so that the tool can be *instantly* withdrawn. Murchey Tools are guaranteed for accuracy and speed. They are durable tools which we will be glad to have you put to the test. Any Murchey you select sent on approval. We also design special tools for special jobs.

At your service on any question pertaining to threads.

MURCHEY MACHINE & TOOL COMPANY

34 Porter Street **DETROIT, MICHIGAN**

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National-Cleveland Cutting Tools

National-Cleveland Cutting Tools are on the job. They are serving the Nation in thousands of shops, factories, garages and manufacturing plants. They are doing their bit—doing it as faithfully in these good times of Peace as they served in the years of strife. The war is history now, but National-Cleveland Cutting Tools are still setting the pace. To quote an enthusiastic A. E. F. friend of ours, "If the Chevron is an emblem of service, then brand it on National-Cleveland Tools."

NATIONAL TOOL COMPANY

Cleveland, Ohio, U. S. A.

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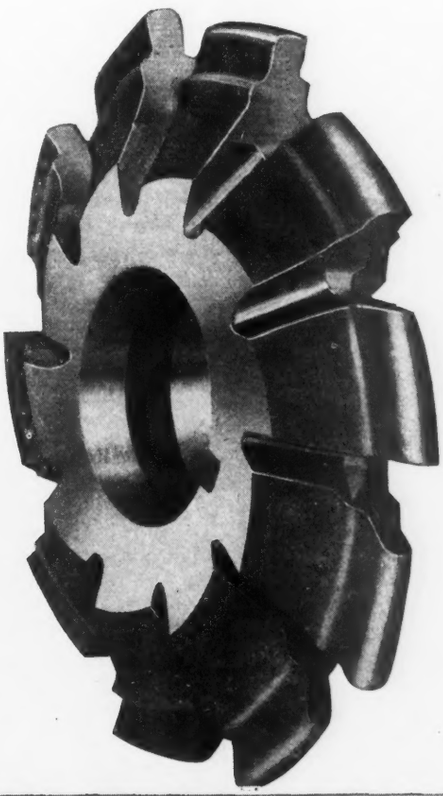


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A New Book for Progressive Designers, Executives, Draftsmen, Toolmakers



Gage Design and Gage Making

By ERIK OBERG and FRANKLIN D. JONES

If you want to know more about the fundamentals of successful interchangeable manufacturing; if you want to know how tolerances are established and why; if you want to know the methods and machines adopted by the largest companies manufacturing on an interchangeable basis; if you want to be able to design practical and accurate gages that will be adaptable to shop work; in short, if you have anything to do with either the use or design of gages, or if you ever expect to have, either as a mechanical executive or designer, you need this new book just off MACHINERY'S presses.

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We shall be glad to send you a copy of "Gage Design and Gage Making" for your free five-day inspection, anywhere in the United States or Canada. We will prepay all delivery charges.

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Developing a Gaging System—Snap and Plug Gages—Contour or Profile Gages—Flush-pin, Sliding-bar and Hole Gages—Thread Gages and Their Production—Making Whitworth Thread Gages—Grinding and Lapping Thread Gages—Lead and Diameter Measurements on Thread Gages—Microscopic Measuring Machines for Testing Accuracy of Contour and Thread Gages—Projection Method of Testing Gage Threads—General Gage-making Practice.

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I should like to take advantage of your special offer and examine free for five days your new book "Gage Design and Gage Making." You may send it to me all postage prepaid. I will either return the book five days after receipt, or I will forward you $3.00 at my convenience within 30 days.

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The shanks of our Rivet Sets are faced to a slight radius. This insures the piston coming in contact in line with the axis of set, increasing the effect of piston stroke on rivets, a particular advantage when hammer cylinders are worn, with a marked reduction in shank breakage.

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Scale graduated in thousandths, divisions 1/16th of an inch apart, making readings easy and without eye strain. Should the work to be tested be jammed or pressed too hard against the contact point, it automatically swings out of the way. Reaches into holes and inaccessible places. Try one.

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Price $3.50
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Gardnerized TAPS and DIES

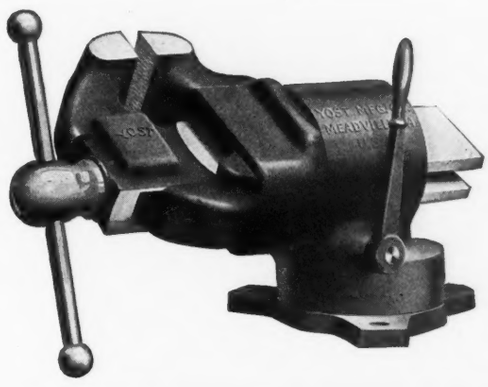
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Special Taps a Specialty

THE GARDNER-BRYAN CO.
CLEVELAND, OHIO, U.S.A.

Yost Vises

First Choice of the Critical

A VISE FOR EVERY NEED

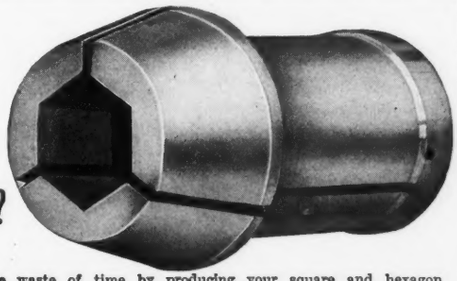


When the skilled mechanic—most critical of judges—needs a new vise he orders from the Yost catalog. He knows of old that it lists the vise he wants, the vise he can depend upon. His choice of Yost vises is entirely practical, he has neither time nor inclination for experiments in efficiency. And the Yost vise never "turns him down." Every job in the shop has its proper "holder" in the Yost line, materials, workmanship and service guaranteed.

Investigate Yost Vises. As a preliminary write for the catalog.

YOST MANUFACTURING CO.
MEADVILLE, PA., U. S. A.

Is Time Money To You?

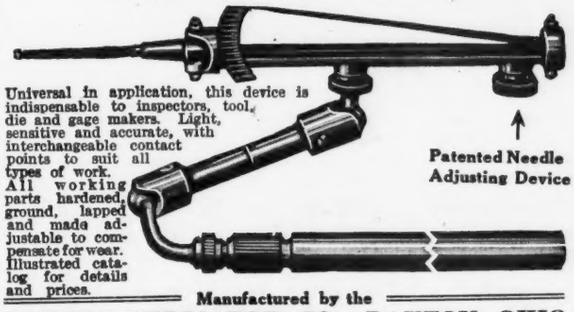


Then stop the waste of time by producing your square and hexagon holes by the old way.
Use the Watts method and drill your square and hexagon holes, either in lathe or drill press, from the hardest to the softest metal. The ONLY up-to-date method known; saves you 80 per cent in time. Time for drilling the hexagon spring collet shown is 2 minutes. No hand work. We have literature telling you how it is done. Write today.

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Deming Precision Test Indicators

Improved Special Type permits instant readings in .0005" the entire length of the scale.



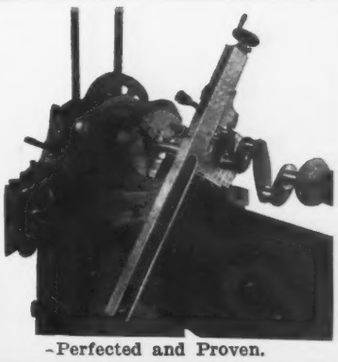
Universal in application, this device is indispensable to inspectors, tool, die and gage makers. Light, sensitive and accurate, with interchangeable contact points to suit all types of work. All working parts hardened, ground, lapped and made adjustable to compensate for wear. Illustrated catalog for details and prices.

Patented Needle Adjusting Device

Manufactured by the
DEMING INDICATOR CO., DAYTON, OHIO
Under the Personal Supervision of Mr. Chas. M. Deming

No Filing
No Offsetting
No Jigs

The Weber Tool turns ALL Pins from ONE setting of the Crank Shaft, ON CENTERS. It is the only tool of its kind that will leave a pin absolutely parallel to the main bearings. The cutter used is a Forming Tool, cutting entire width of pin at once. A micrometer dial enables operator to gauge his cuts and turn all pins to a uniform size.



-Perfected and Proven.

Weber Crank-Pin Re-Turning Tool

How many times have you assembled a gas engine, knowing full well that the crank shaft needed trueing up? You did not want to send it out and delay your customer. You knew, too, that it would cost considerable to have it done.

With the Weber Tool you can do this work whenever necessary. NO DELAY—NO EXPENSE.

Why not do this work in your shop and have more satisfied customers and put more profits in your own pocket? The Weber Tool is guaranteed to turn crank-pins within as close limits of accuracy as any other known method.

SAWYER-WEBER TOOL MFG. CO. — TOOLS OF SW ACCURACY — WEBER RE-TURNING METHOD — LOS ANGELES — CHICAGO

Picture at top shows Weber Tool in operation on 4-throw Crank Shaft. All four pins are turned and finished from this one setting. Write for Circular and prices.

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349 South Alameda Street LOS ANGELES, CALIFORNIA



HANGERS FOR IMMEDIATE SHIPMENT!

Special Ring Oiling Hangers for High Speed Work

48 — $2^{15}/_{16}$" x $10^{3}/_{4}$" drop.
60 — $2^{15}/_{16}$" x $12^{1}/_{2}$" drop.
52 — $2\ ^{7}/_{16}$" x $10^{3}/_{4}$" drop.

Additional Hangers Can Be Furnished On Order.

Manufacturers of

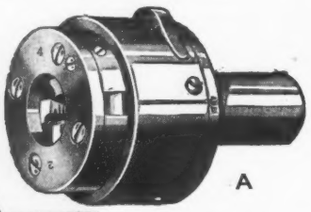
A Complete Line of Transmission Machinery

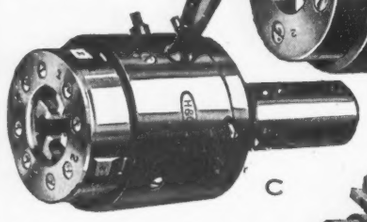
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H&G DIE HEADS

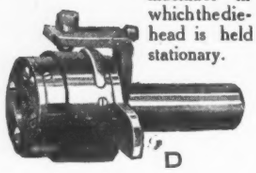
H & G dieheads are made in three standard styles, and each style in several sizes. They are adaptable to practically all machines on which threading is done.

Style A—is for automatics like the Cone, Gridley, National Acme, threading machines and bolt cutters in which the diehead rotates.





Style C—is for turret lathes, hand screw machines, and similar machines in which the diehead is held stationary.



Style D—is new and it is a masterpiece. It is especially designed for Brown & Sharpe automatics but can be used on other machines cutting small work.

Send for New 96 Page Catalog

This book is a real contribution to the science of thread-cutting and should be in the hands of every man in the business.

H & G Works—The Eastern Machine Screw Corp.
23-43 Barclay Street New Haven, Conn.



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If machine work is part of the process, VIXEN FILES are welcomed, by both superintendent and labor.

VIXEN FILES do more work with less expenditure of energy and do it faster than any other type of file made. The teeth are so formed that they **cut** instead of scrape, at the same time that they shed the cuttings.

They cost more of course, but save money because they **do more** and **can be sharpened and re-sharpened.**

How much do they save?

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Vixen Tool Company, Newark, N. J.

VIXEN CURVED TOOTH FILES

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Tool chest economy means a "Union"—the chest of stauncher construction for enduring service. Built of solid oak, with top and bottom rabbeted in and frame joints lock-cornered, not dove-tailed, it outlasts the tools it contains.

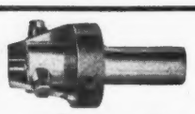
UNION TOOL CHESTS are built in 24 styles and sizes—ONE OF WHICH IS JUST THE KIND YOU WANT. An economical chest for every mechanic's needs. They are all sold on a "Satisfaction or Money-back" guarantee. Just look them over and be convinced.



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TANGENT CUT BOX TOOLS

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QUALITY
WITH
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TANGENT CUT
BOX TOOLS





This is Model D— Strong Rigid Compact— Look it over

All movable parts in this tool are mounted on strong one-piece steel body, so designed as to allow ample chip clearance—no clogging.

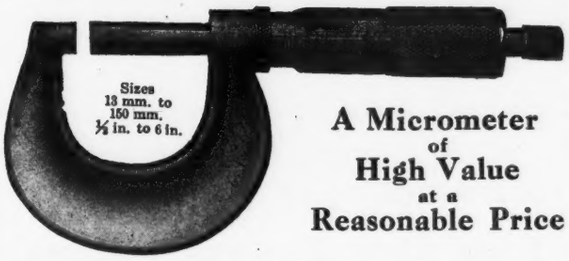
All movable parts travel in straight lines, providing proper bit clearance and work support at proper angles for all diameters. All movements backed up by direct thrust screws, allowing for sensitive adjustment and providing permanent lock when adjustment is made.

Cutting tool can be removed, ground and replaced without changing a single adjustment.

Be assured of quality and quantity production by using up-to-date Box Tools. Write for detailed information.

WATSON MFG. CO., Toledo, Ohio

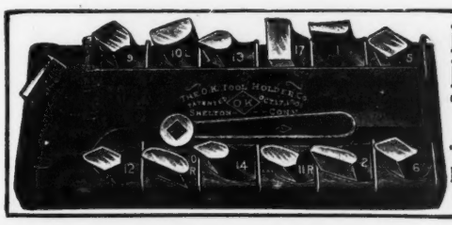
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A Micrometer
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SIMPLEX THE SELF READING MICROMETER
MANUFACTURED BY
CONSOLIDATED TOOL WORKS, Inc.
261 BROADWAY NEW YORK



LATHE and PLANER TOOLS
THE O.K. TOOL HOLDER CO.
Shelton, Conn.

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The work is placed on rotating discs and the drill applied until sufficient stock is removed to secure a proper balance.

BELT OR MOTOR DRIVE
Details on request



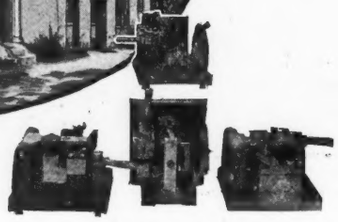
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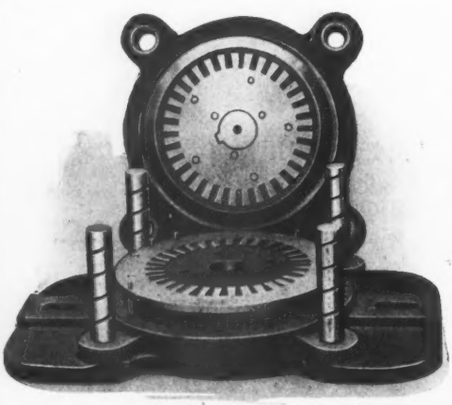


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We are prepared to design tools to obtain any required production, to submit them for your OK and then construct them to best possible advantage—high quality, reasonable price and *Prompt Delivery*.

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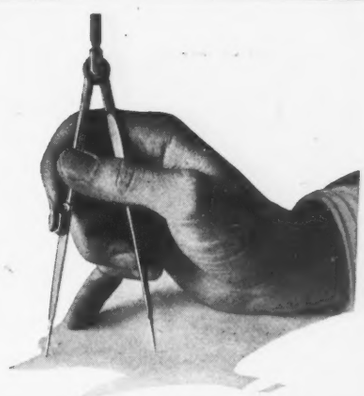
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Design Special Machinery and Tool Equipments

Special labor saving machines being designed constantly. Specialize in complete tooling equipments for modern manufacture. Arrangements made for building equipment which we design.

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We are Prepared to Design a Single Jig, Fixture or Special Machine, or we will Handle the entire Tooling Requirements of the Largest Concerns.

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30 MINUTES FROM NEW YORK CITY.

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"Practice makes the master" whether the work is hoeing corn or building an intricate fixture. The breadth of our experience is particularly valuable in designing fixtures. For every one built in your toolroom we build a hundred; so it stands to reason we can do the work quicker and more economically, if not better.

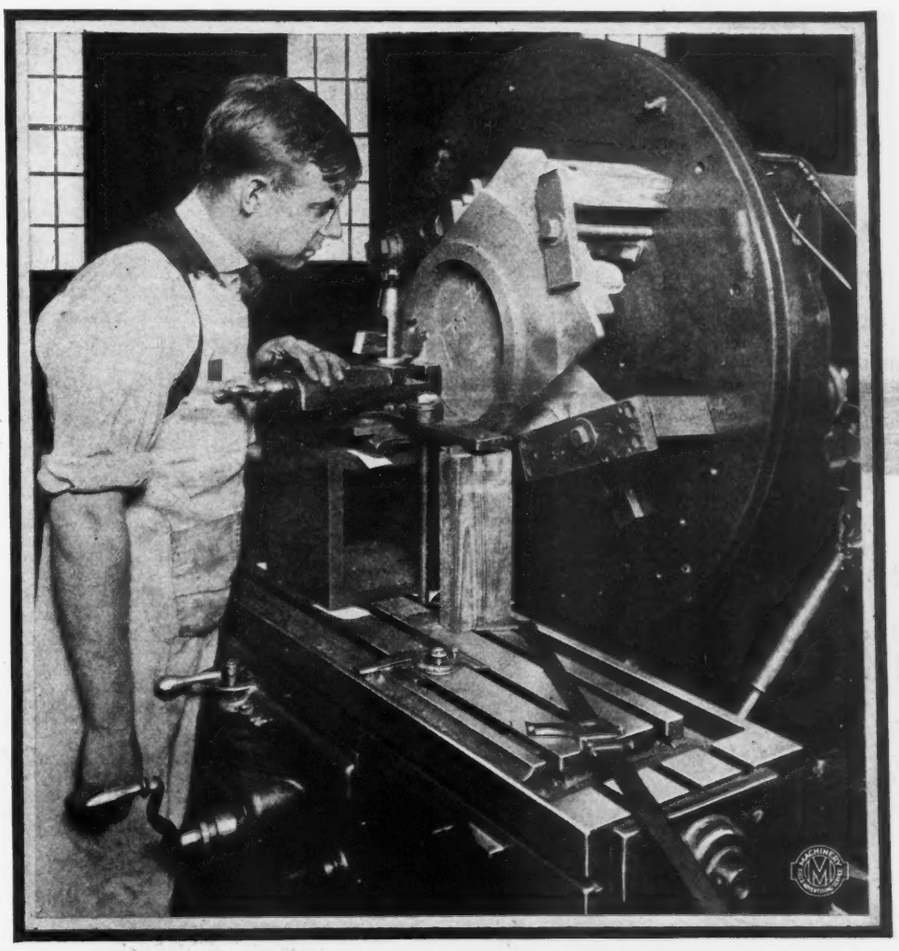
Our designers bring to each new problem the cumulative knowledge that comes from practice and long experience in making tools for particular manufacturers.

You reap the benefit when you place your order with us—whether for Dies, Jigs, Gages, Fixtures or other Special Equipment.

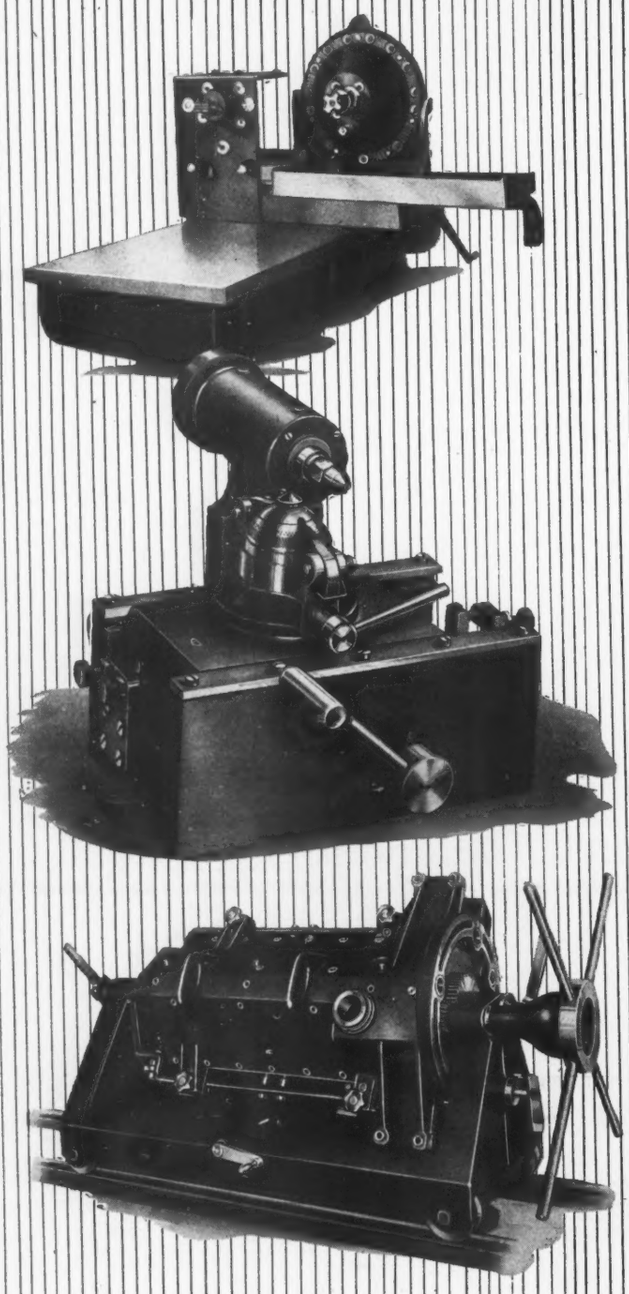
We would be glad for an opportunity to estimate.

URBANA TOOL & DIE COMPANY

URBANA **OHIO, U. S. A.**



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Insures Tools, Jigs and Fixtures That Guarantee the Accuracy of Your Finest Machines

The accuracy required in the manufacture of interchangeable parts is most economically achieved by the use of accurate and convenient jigs and fixtures.

Carroll Tools insure correct construction for intricate machine parts; engineers who know their business design the thoroughly practical jigs, fixtures, etc., that make big output possible on the most intricate work.

Are you planning something new? Carroll Engineers can help you make it economically.

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THE CARROLL ENGINEERING CO.

TOOL ENGINEERS AND BUILDERS

Main Office and Factory:

DAYTON OHIO, U.S.A.

Carroll ENGINEERING SERVICE

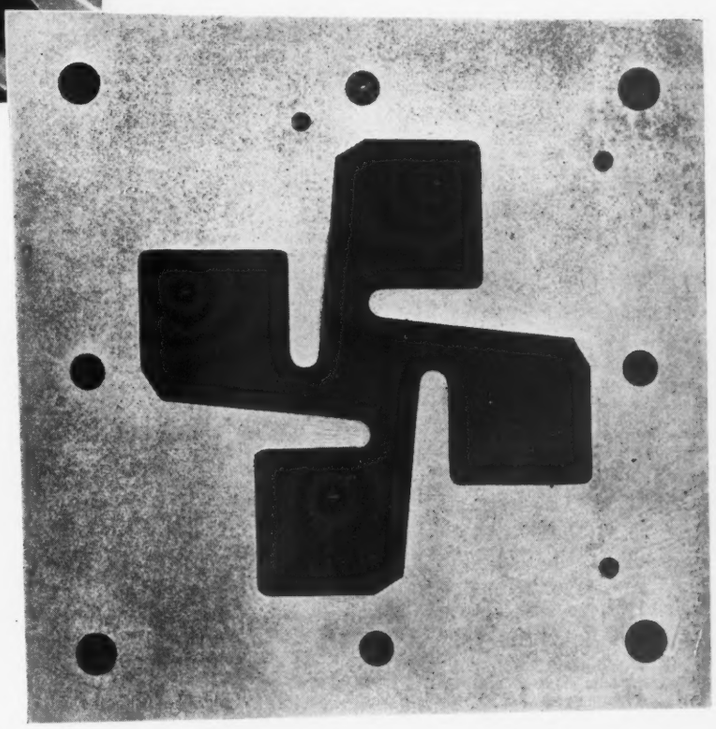
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Toolroom, Contracting and Manufacturing Departments

Increasing your output need not necessarily involve enlarging your facilities. By making yourselves at home in our shop—using our toolroom, contract shop and manufacturing departments to handle your special work—you can release all your toolroom and many manufacturing machines, together with the operators qualified to use them, and divert them to your regular production work.

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"From Idea to Finished Product"

is our slogan and we offer you the most advantageous form of service anywhere along the line — quality, delivery and cost.

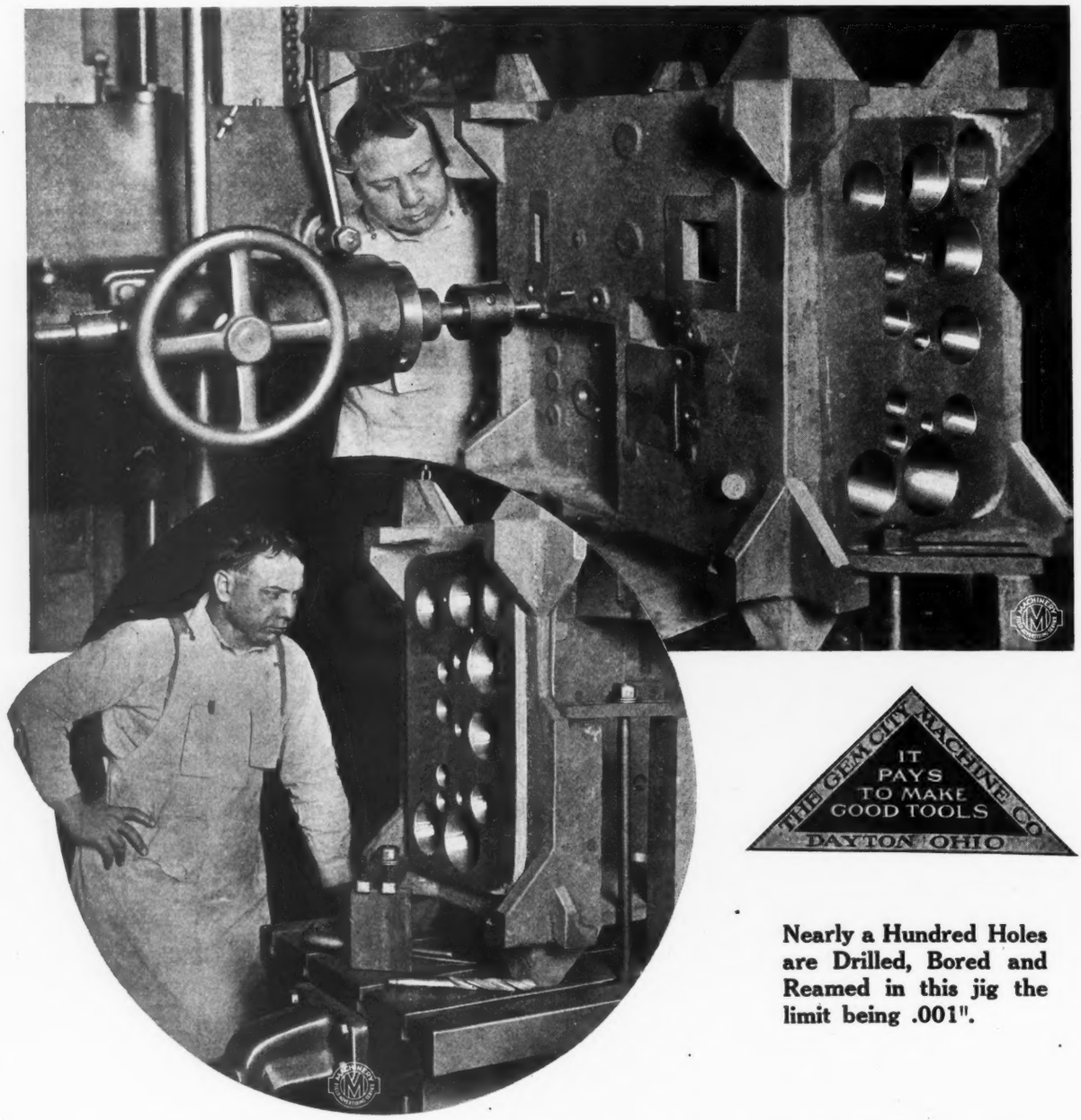
The accompanying photographs were taken in our die making department. The stripper plate shown complete and in process of machining is designed for use in stamping fan blades.

Tell us how we may serve you.

RELIANCE DIE & STAMPING COMPANY

515 North LaSalle Street — CHICAGO, ILLINOIS, U. S. A.

Complicated Precision Jigs Present No Difficulties to Our Completely Equipped Plant



IT PAYS TO MAKE GOOD TOOLS
THE GEM CITY MACHINE CO
DAYTON OHIO

Nearly a Hundred Holes are Drilled, Bored and Reamed in this jig the limit being .001".

A mighty good boring job, you'll say. A hundred, odd, holes drilled, bored and reamed, and every one plus or minus .001" *at most.* Some of these holes are at an angle with the face of the other holes—the determination of such angles must be accurate. Some of the holes are for establishing gear centers—you know what that means. Interesting to note that there are 138 bushings, permanent and slip, in this jig. May we help you out? Write.

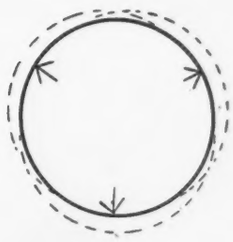
THE GEM CITY MACHINE COMPANY

Manufacturing Machinists

434 East First St. **DAYTON, OHIO**

Brehm Trimming Dies

Cut Trimming Costs Three to Four Hundred Per Cent.



Below are two sets of Brehm Trimming Dies with "before and after" samples of their work. The large set trims switch boxes, 8″ square by 4″ deep, made of 1/16″ metal, at the rate of 750 per hour. The small die is used for ferrules—⅝″ diam., 9/16″ deep of 1/32″ metal — which are trimmed at a minimum rate of 1000 per hour.

Compare these figures with results obtained on similar work trimmed in a lathe or cutting-off machine and you'll readily understand why Brehm Trimming Dies are so extensively used for trimming practically all classes of stampings.

"Products" of some recently developed Brehm Dies are here shown together with a sketch illustrating the cam-actuated three-way motion by which the die strips off the superfluous metal. Estimates from samples or blueprints. Details on request.

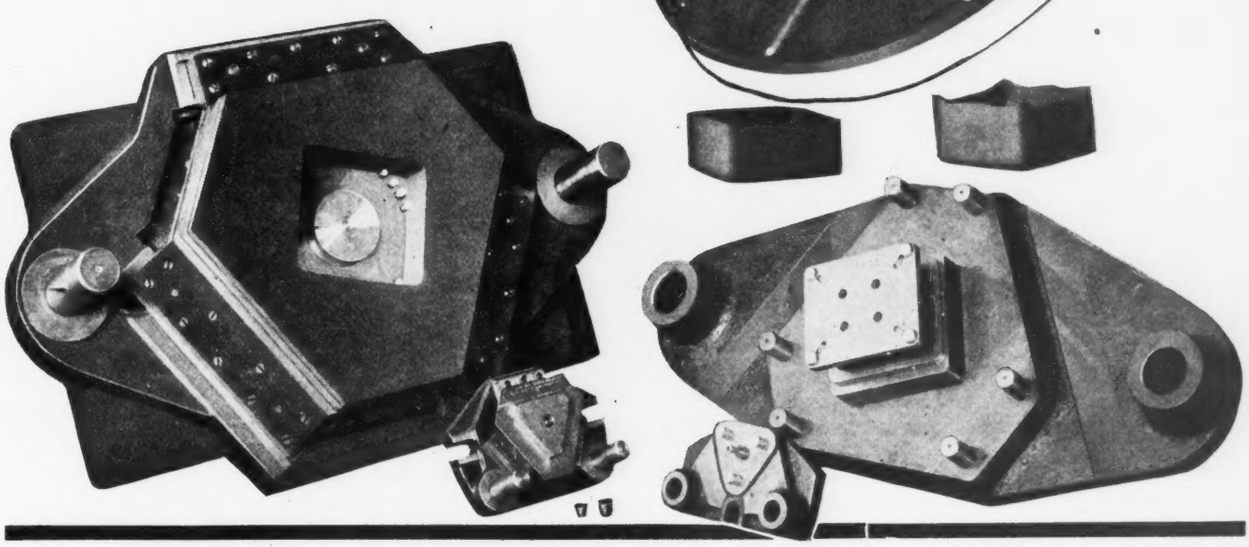


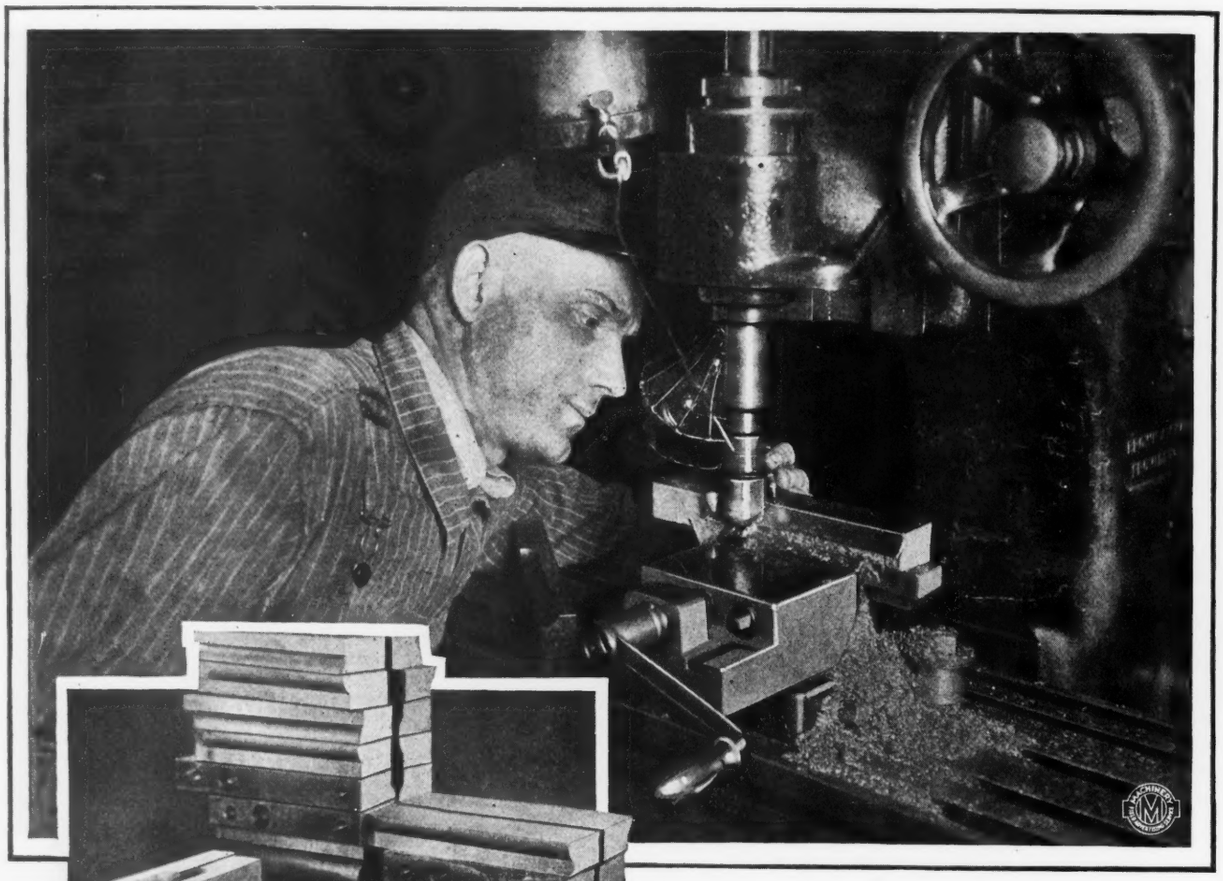
Brehm Trimming Dies

U. S. Patent May 20, 1919
Foreign Patents Pending

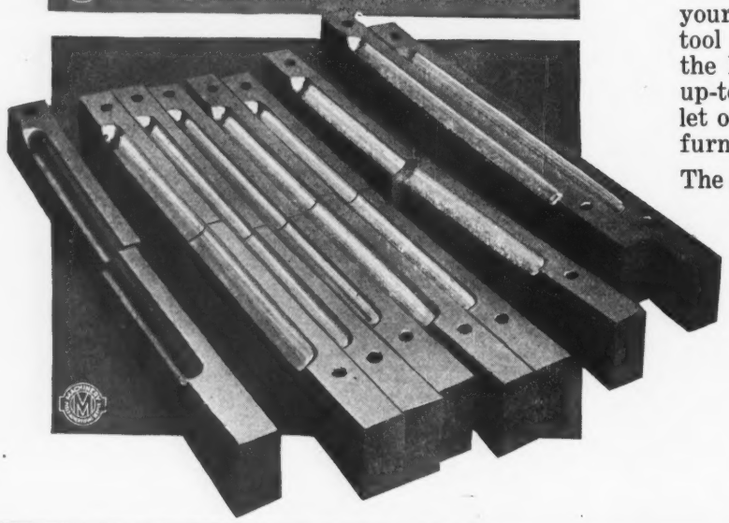
CITY ENGINEERING CO.
DAYTON, OHIO

TOOLS - DIES - JIGS - FIXTURES
GAGES - SPECIAL MACHINERY









Put Our Roof Over Your Toolroom

Let us shoulder the responsibility for the production of your DIES, TOOLS, JIGS, FIXTURES and GAGES. Make our tool department your tool department. Entrust us with this part of your work—put our roof over your die, tool and jig division. We are equal to the largest demands. Equipment right up-to-the-minute. And our work—well, let our customers speak for that. We'll furnish list of clients on request.

The accompanying pictures show a number of Louver die sections for piercing and forming automobile hoods. These dies are built up in sections. The milling machine operation shows the roughing of one of these sections—note the curved lines in these pieces.

Drop us a line for particulars of "Columbus" Service.

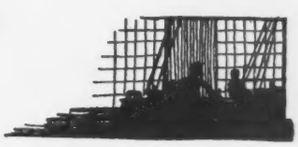
THE COLUMBUS DIE, TOOL & MACHINE CO.

COLUMBUS OHIO, U. S. A.



Let Us Be Your Toolroom

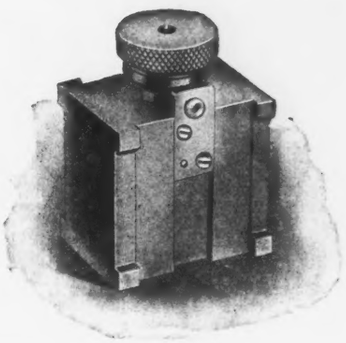
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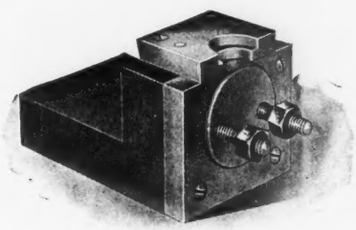
Tool-room swamped with work? Impossible to keep pace with the demands of modern shop practice?

Let us lend a hand.

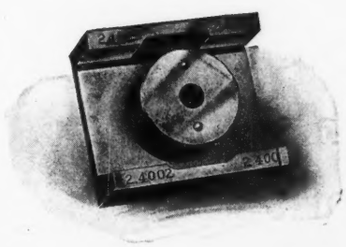
We're equipped to design and construct tools, dies, jigs, gages, etc., of the highest order, and are official toolmakers to many of the largest and most successful manufacturers in the country.



Tools, Dies, Jigs, Gages, Fixtures and Special Machinery.



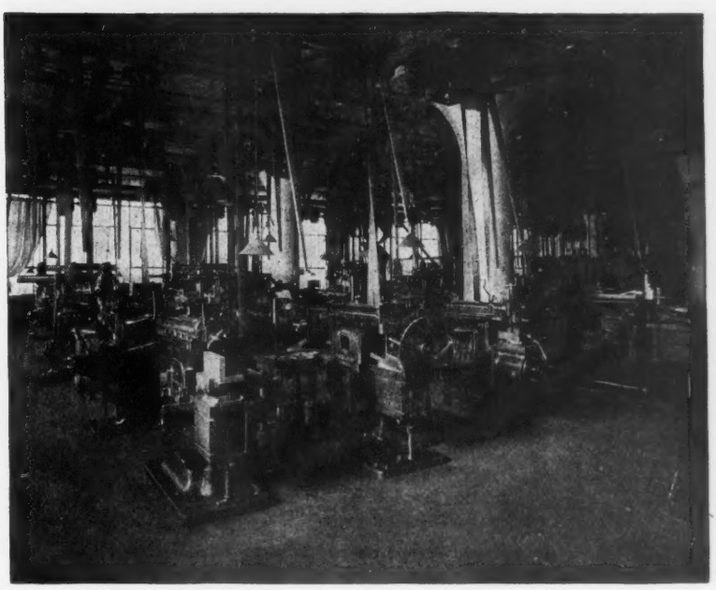
Foolproof, Easy to operate, Productive and Economical

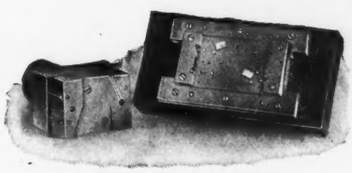


Our "tool-room" occupies 35,000 square feet of floor space and contains 200 up-to-date machines. Our working force is 300 strong—the pick of the country's most skilful mechanics, and we have specialized for years on work such as the average tool-room has difficulty in handling.

We offer a real service to rapidly expanding industries which are handicapped in reaching or maintaining the necessary production: up-to-date tools that are foolproof, easy to manipulate and assure the largest possible production at minimum cost.

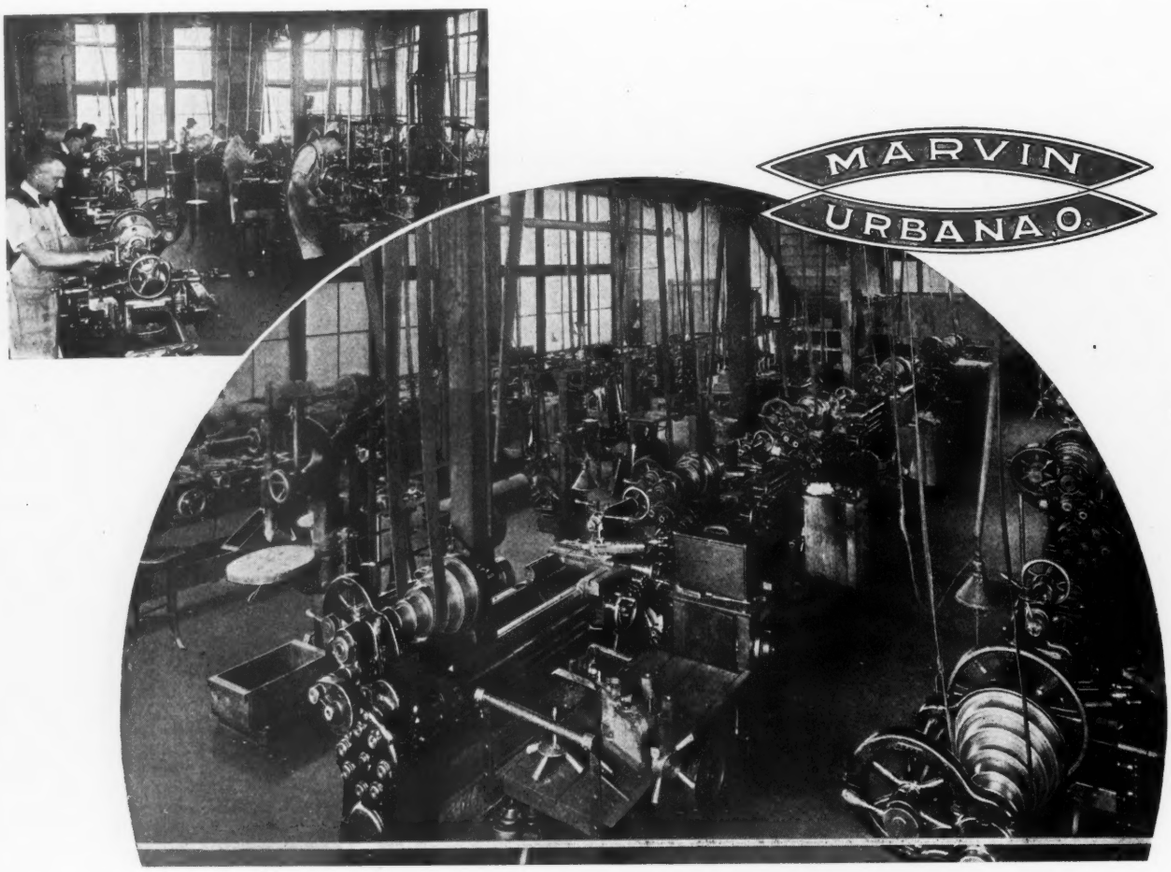
Let us estimate on your requirements.





ARTHUR BROCK, Jr. TOOL & MFG. WORKS

533 North 11th Street **Philadelphia, Pa., U. S. A.**



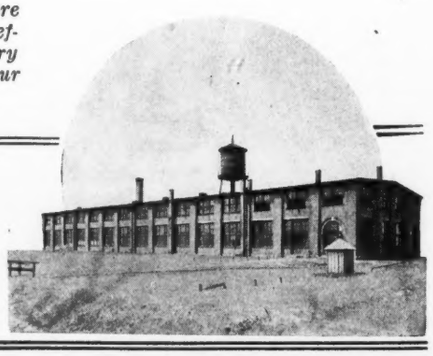
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Equips Each Department With the Finest Machines for the Work

The "parts that make the whole" never received closer attention than in the Marvin endeavor to live up to their code of "Perfect Service."

Each machine in each department is as carefully considered as though the accuracy of each piece of work depended solely on the operation performed there.

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Marvin Service and Marvin Products are the result of our carefully calculated effort to make Tools and Special Machinery in the way that is most profitable to our customers and ourselves. Try us.



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Are Your Metal Stamping Dies Satisfactory?

There are so many factors entering into the production of dies that the only way of being sure you are right is to see they have the right name behind them.

Meyers' Dies have an International reputation for correctness of design, carefulness of construction, all around quality. You can be sure they're *right.*

We have recently produced a number of Dies for some of the largest concerns in the country. The completion of these contracts leaves us open for your business.

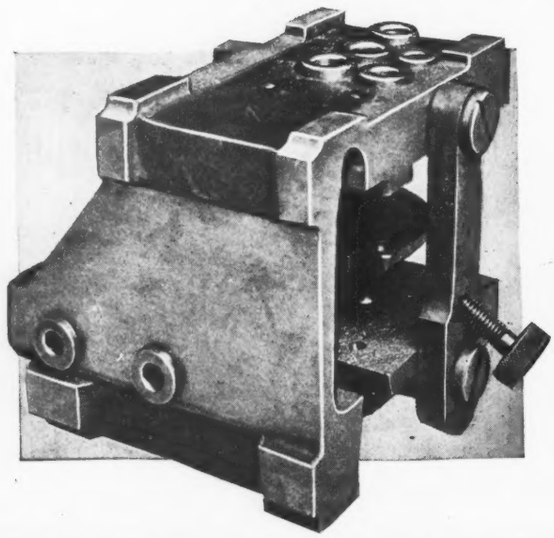
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W. F. MEYERS GAGE CO.

BEDFORD **INDIANA**

MODERN TOOLMAKERS of Newark

NEW TOOLS—SPECIAL MACHINES



You Know How You Want Them
We Know How To Make Them

We design and make Dies, Jigs, Gages, Fixtures and Special Machines of all descriptions, as well as such specialties as Impression Molds for Rubber and Bakelite.

We are toolmakers to manufacturers who are particular about their work. May we show you what we can do?

THE MODERN TOOL & MACHINE WORKS, Inc.
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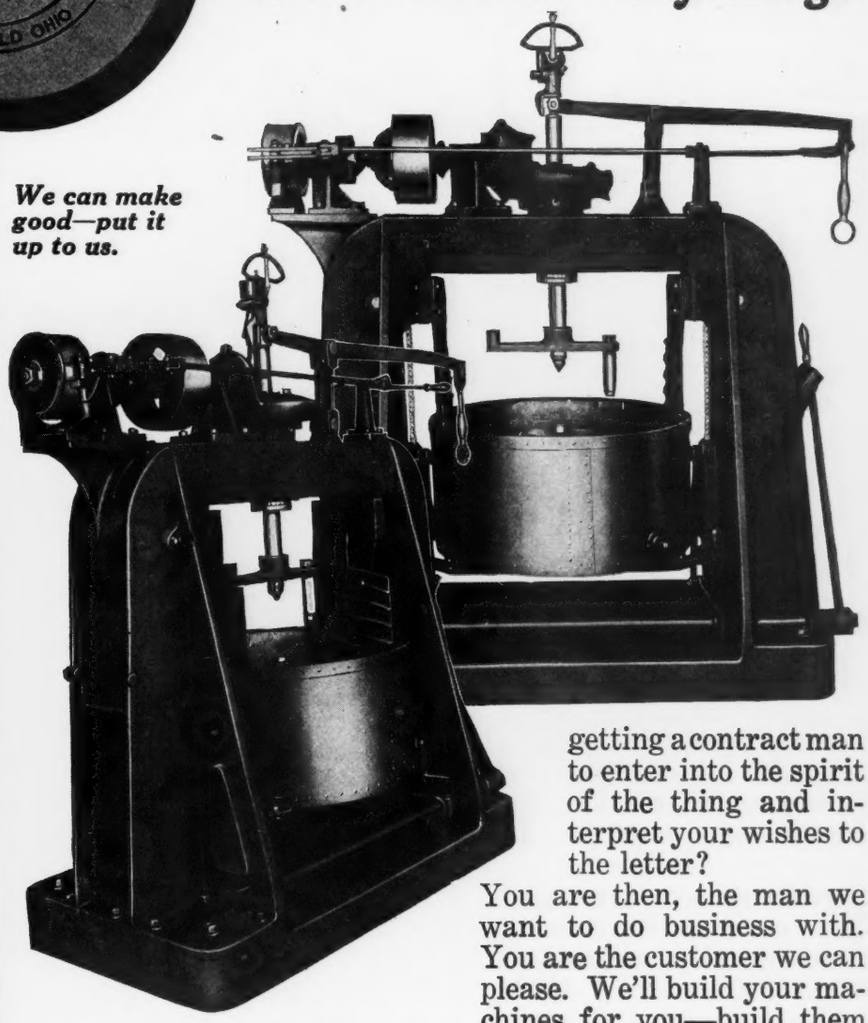
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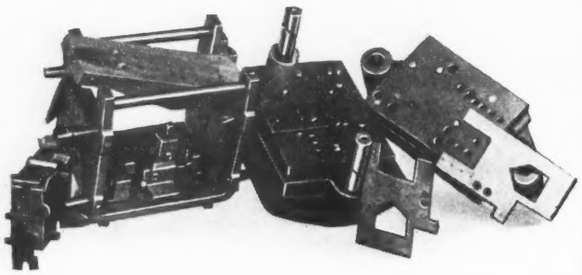
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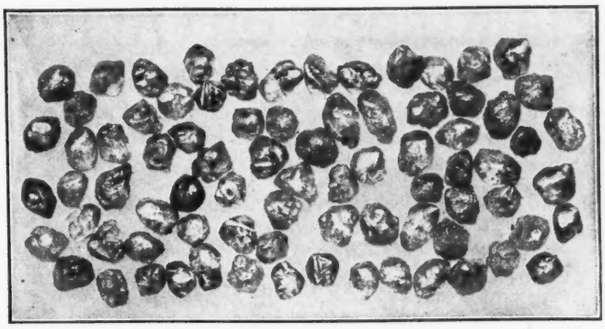
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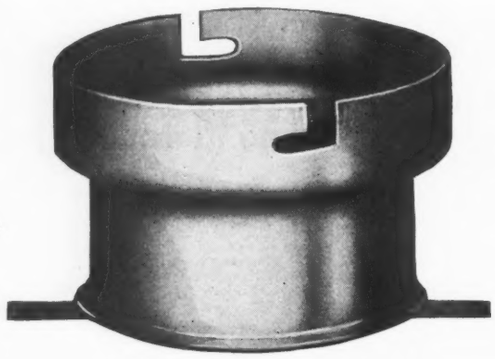
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WANTED—DRAFTSMEN, experienced on tools, special and automatic machinery. State age, experience and salary wanted. Box 325, care MACHINERY, 148 Lafayette St., New York.

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FOREMAN WANTED to take charge of tool room of large Middle West manufacturing plant, building heavy machinery and contractors equipment. Must possess wide experience and be capable of handling men. State in your first letter education, age, nationality, experience, salary expected and when; answers held in strictest confidence. Box 324, care MACHINERY, 148 Lafayette St., New York.

WANTED: GENERAL SUPERINTENDENT for plant in Middle West employing from 125 to 150 men, manufacturing track, hangers, and building specialties. To take complete charge of production, including drafting and engineering departments. Must have had previous successful experience. Give references, age, and state salary expected. Box 318, care of MACHINERY, 148 Lafayette St., New York.

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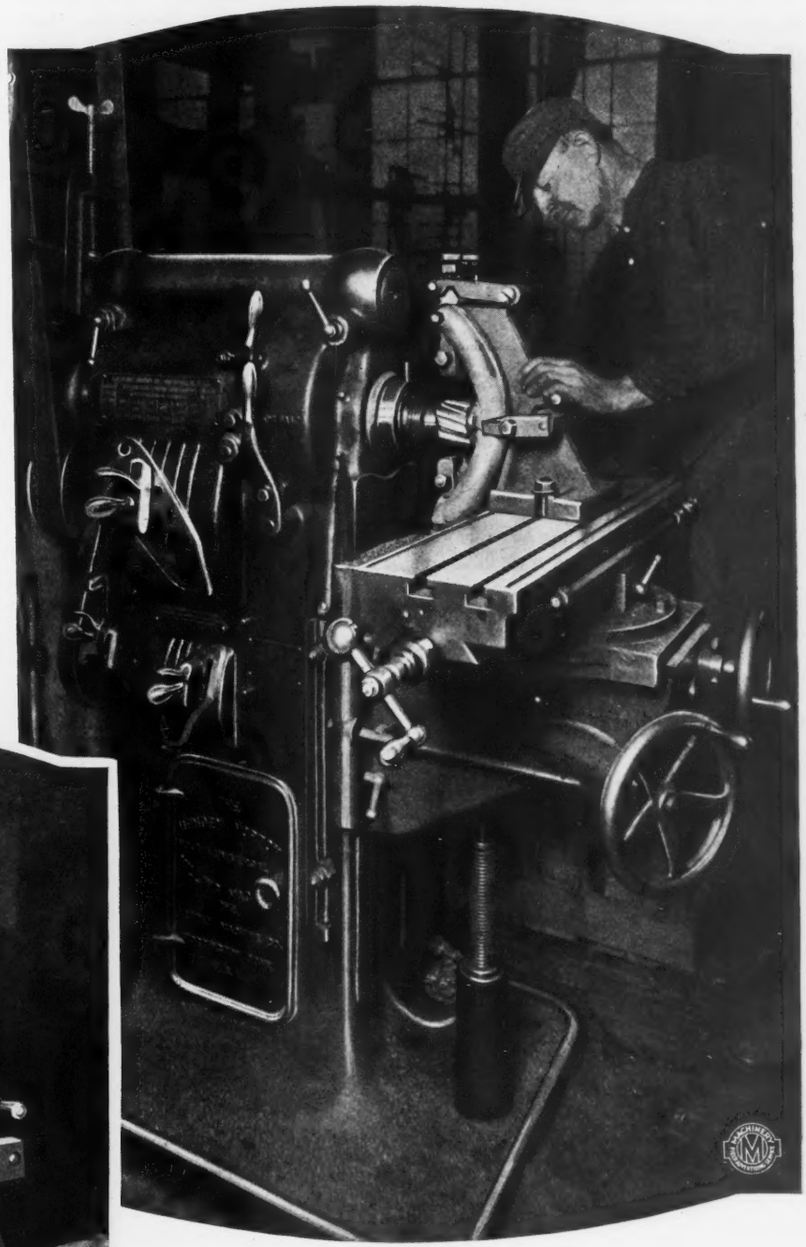
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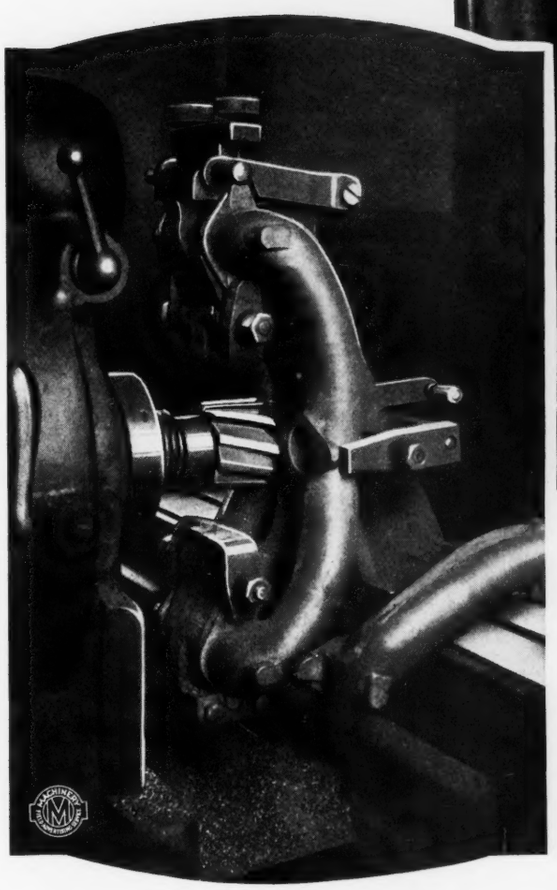
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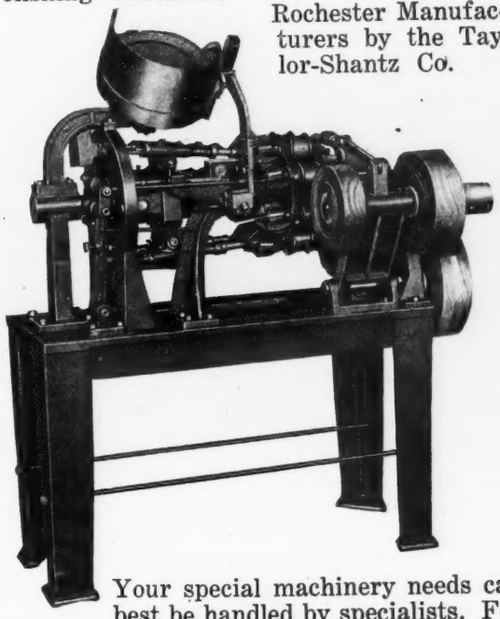
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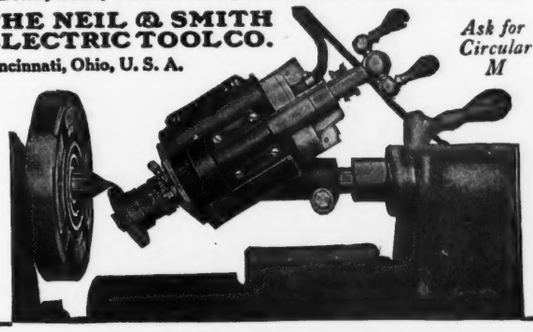
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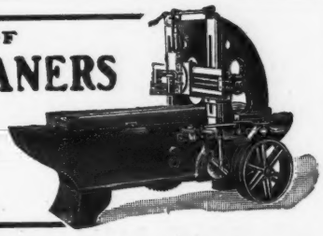
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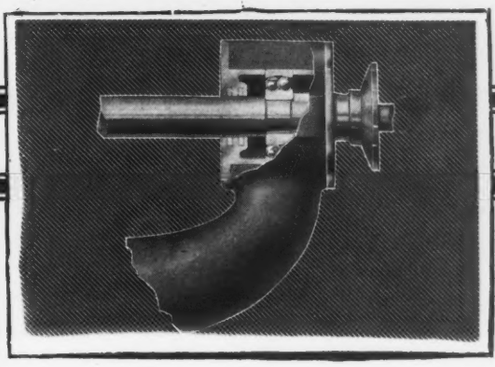
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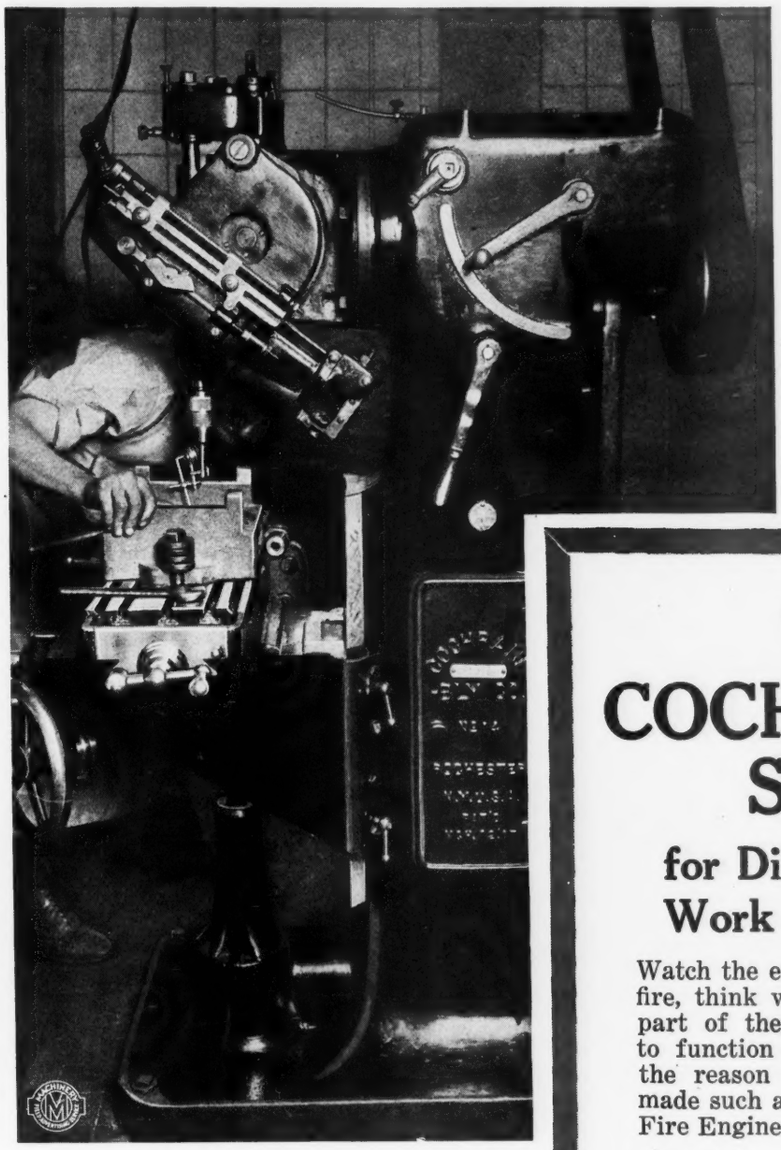
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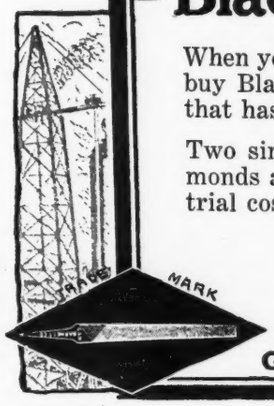
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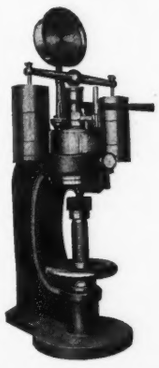
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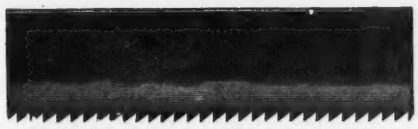
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Dietzgen Co., Eugene, 166 W. Monroe St., Chicago, Ill.
Economy Drawing Table & Mfg. Co., Adrian, Mich.
New Britain Mch. Co., New Britain, Conn.

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Western Tool & Mfg. Co., Springfield, Ohio.

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Federal Electric Co., 8700 So. State St., Chicago, Ill.

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Gages, Comparator
Golden Co., 405 Lexington Ave., N. Y.

Gages, Depth
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Harris Engineering Co., H. E., Bridgeport, Conn.
Marvin Mfg. Co., W. B., Urbana, O.
Rogers Wks., Inc., J. M., Gloucester City, N. J.
Slocomb Co., J. T., Providence, R. I.
S-P Manufacturing Co., Cleveland, O.
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Titan Automatic Tool Co., Inc., 25 W. Broadway, New York.

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Pratt & Whitney Co., Hartford, Ct.
Purves Mfg. Co., Syracuse, N. Y.
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Rogers Works, Inc., John M., Gloucester City, N. J.
S-P Manufacturing Co., Cleveland, O.
Starrett Co., L. S., Athol, Mass.
Steel Products Engineering Company, Springfield, O.
Taft-Peirce Mfg. Co., Woonsocket, R. I.
Taylor-Shantz Co., Rochester, N. Y.
Titan Automatic Tool Co., Inc., 25 W. Broadway, New York.
Urbana Tool & Die Co., Urbana, O.

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Long-Henkel Mfg. Co., Reading, Pa.
Meyers Gage Co., W. F., Bedford, Ind.
Modern Tool & Mch. Works, Newark, N. J.

Gages, Standard
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Johansson, C. E., Inc., Poughkeepsie, N. Y.

Gages, Surface
Brown & Sharpe Mfg. Co., Providence, R. I.
Columbus Die, Tool & Mch. Co., Columbus, O.
Goddard Tool Co., Chicago, Ill.
Goodell-Pratt Co., Springfield, Mass.
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Marvin Mfg. Co., W. B., Urbana, O.
Pratt & Whitney Co., Hartford, Ct.
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Starrett Co., L. S., Athol, Mass.
Taylor-Shantz Co., Rochester, N. Y.
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Knauel Tool Works, Rock Island, Ill.
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Bicknell-Thomas Co., Greenfield, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
City Engineering Co., Dayton, O.
Golden Co., 405 Lexington Ave., N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
Illinois Tool Works, Chicago, Ill.
Johansson, C. E., Inc., Poughkeepsie, N. Y.
Meyers Gage Co., W. F., Bedford, Ind
Modern Tool & Mch. Works, Newark, N. J.
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Lumen Bearing Co., Buffalo, N. Y.

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Barber-Colman Co., Rockford, Ill.
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Cincinnati Gear Cutting Machine Co., Cincinnati, O.
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Morey & Co., Inc., 50 Church St., New York.
Lees-Bradner Co., Cleveland, O.
Meisselbach-Catucci Mfg. Co., Newark, N. J.
Newark Gear Cutting Mch. Co., Newark, N. J.
Reynolds Machine Co., Massillon, O.

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Gear Cuttin Machines, Spiral Bevel
Gleason Works, Rochester, N. Y.

Gear Cutting Machines, Spiral Pinion Rougher
Gleason Works, Rochester, N. Y.

Gear Cutting Machines, Spur (Rotary Cutter)
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Cincinnati Gear Cutting Mch. Co., Cincinnati, O.
Flather Mfg. Co., Nashua, N. H.
Gould & Eberhardt, Newark, N. J.
Hercules Machine & Tool Co., Inc., 50 Church St., New York.
Morey & Co., Inc., 50 Church St., New York.
Newark Gear Cutting Mch. Co., Newark, N. J.
Waltham Machine Works, Waltham, Mass.
Whiton Mach. Co., D. E., New London, Conn.

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Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Horsburgh & Scott Co., Cleveland, O.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston, Mass.
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Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Wks., Phila., Pa.
Simonds Mfg. Co., Pittsburgh, Pa.
Stahl Gear & Mch. Co., Cleveland, O.
Van Dorn & Dutton Co., Cleveland, O.
Westingohouse Electric & Mfg. Co., E. Pittsburgh, Pa.

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Caldwell & Son Co., H. W., 17th and Western Ave., Chicago, Ill.
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Cullman Wheel Co., 1339 Altgeld St., Chicago, Ill.
Davis, Rodney, Philadelphia, Pa.
Diefendorf Gear Corp., Syracuse, N. Y.
Earle Gear & Mch. Co., 4705 Stenton Ave., Philadelphia, Pa.
Fawcus Machine Co., Pittsburgh, Pa.
Fellows Gear Shaper Co., Springfield, Vt.
Flather Mfg. Co., Nashua, N. H.
Foote Bros. Gear & Mch. Co., 210 N. Carpenter St., Chicago, Ill.
Ganschow Co., Wm., Washington Blvd. and Morgan St., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Gleason Gear Works, Rochester, N. Y.
Grant Gear Works, Inc., Boston, Mass.
Harrington, Son & Co., Inc., Edwin, Philadelphia Pa.
Hindley Gear Co., Philadelphia, Pa.
Horsburgh & Scott Co., Cleveland, O.
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Meisselbach-Catucci Mfg. Co., Newark, N. J.
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Nuttall Co., R. D., Pittsburgh, Pa.
Philadelphia Gear Works, Philadelphia, Pa
Simonds Mfg. Co., Pittsburgh, Pa.
Stahl Gear & Mch. Co., Cleveland, O.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

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Fawcus Machine Co., Pittsburgh, Pa.
Newark Gear Cutting Mch. Co., Newark, N. J.
Lees-Bradner Co., Cleveland, O.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.

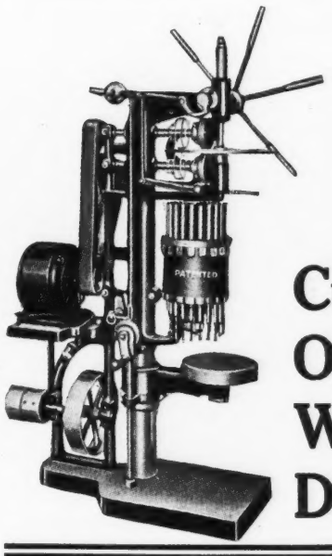
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Grant Gear Works, Inc., Boston, Mass.
Harrington, Son & Co., Inc., Edwin, Philadelphia Pa.
Meisel Press Mfg. Co., 948 Dorchester Ave., Boston, Mass.
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Stahl Gear & Mch. Co., Cleveland, O.
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Diefendorf Gear Corp., Syracuse, N. Y.
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Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros. Gear & Mch. Co., 210 N. Carpenter St., Chicago, Ill.
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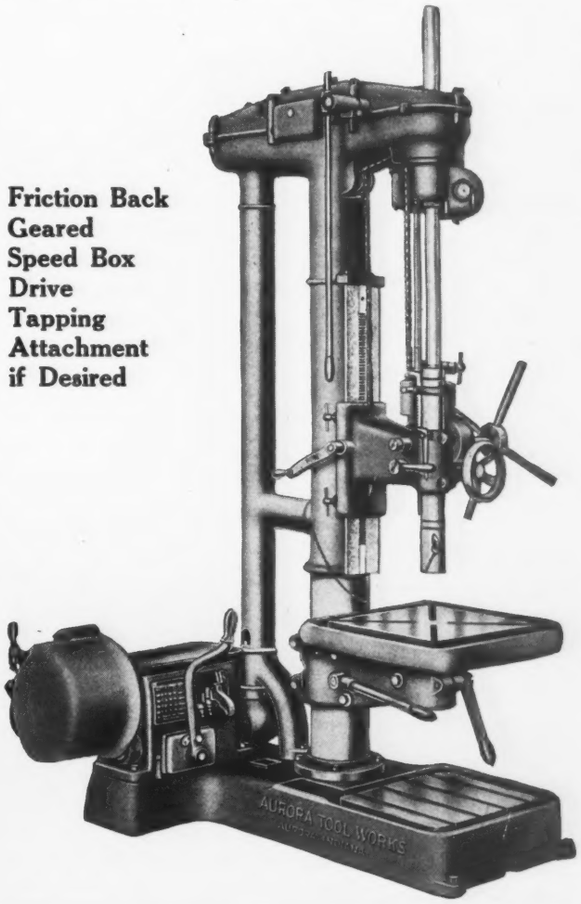
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Machinery Co. of America, Big Rapids, Mich.
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Norton Co., Worcester, Mass.
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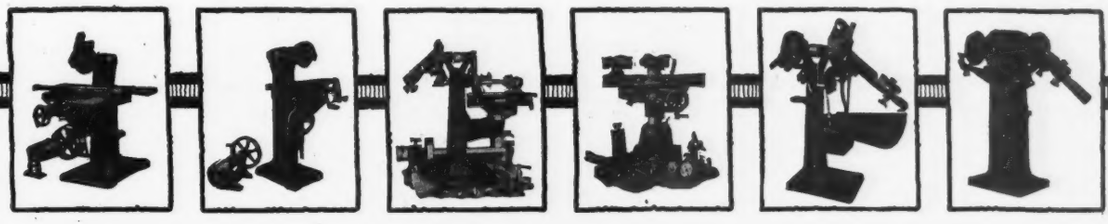
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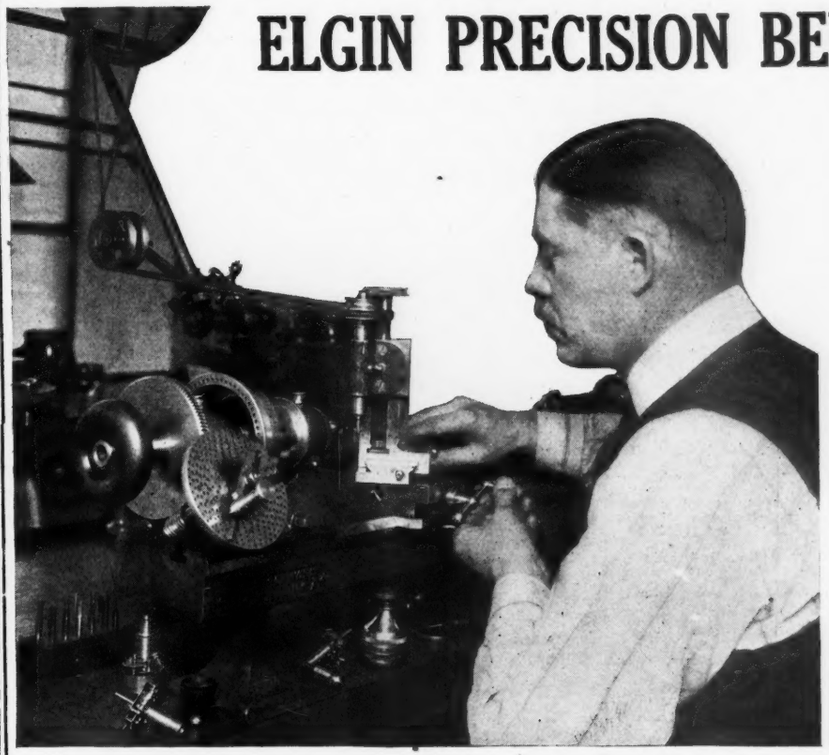
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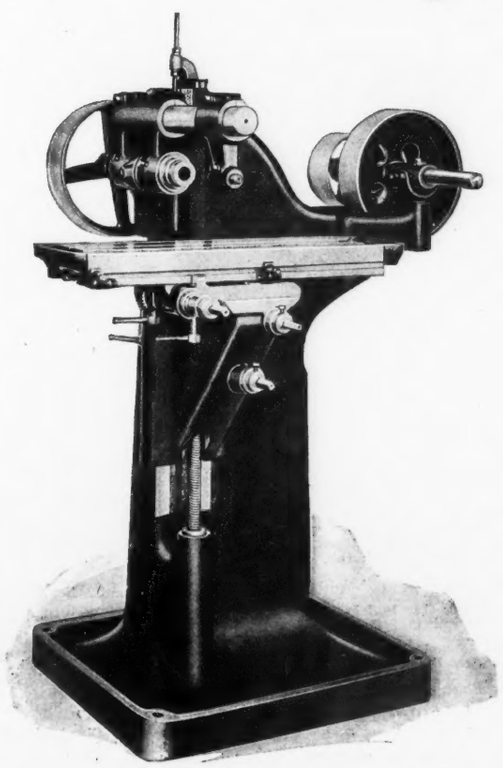
Particularly well adapted for tool room, experimental and fine machine work, the large number of attachments which can be used makes these machines adaptable for a large variety of precision work.

We make lathes and their attachments, countershaft equipments, and complete outfits for precision bench work. Our catalogue, yours for the asking, contains complete descriptions.

The Collins Safety Razor Company, Chicago, Ill., use this Elgin for cutting small gears and cutters, and for experimental work. They have twenty-five Elgin Precision Lathes, and say "They are reliable, accurate, easy to set up, and universally adaptable."

ELGIN TOOL WORKS, Elgin, Illinois

What is it Costing You to Mill Small Parts?



Milling is pretty much the same everywhere as an operation; but it varies greatly as to cost. An economical machine for small accurate parts is the "Standard" Hand Milling Machine. The quality of its work equals that of the high priced machines — and its record for speed is second to none. We furnish this machine with vertical spline milling head; fully automatic, power longitudinal feed to table with quick return by hand; Trahern pump; and design fixtures for slabbing, slotting, cam cutting, hobbing, etc. Built for light, medium and heavy duty.

Write for complete description.

STANDARD ENGINEERING WORKS
Pawtucket Rhode Island

Monarch Mch. Tool Co., Sidney, O.
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Oliver Machinery Co., Grand Rapids, Mich.
Porter-Cable Mch. Co., Syracuse, N. Y
Pratt & Whitney Co., Hartford, Ct.
Reed-Prentice Co., Worcester, Mass.
Rivett Lathe & Grinder Co., Brighton, Boston, Mass.
Rockford Tool Co., 2502 Eleventh St., Rockford, Ill.
Sawyer-Weber Tool Mfg. Co., Los Angeles, Cal.
Sebastian Lathe Co., Cincinnati, O.
Seneca Falls Mfg. Co., Inc., 381 Fall St., Seneca Falls, N. Y.
Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.
Vandyck Churchill Co., 149 Broadway, New York.
Willard Mch. Tool Co., Cincinnati, O.

Lathe Centers, Ball Bearing
Moller Mch. Co., New Rochelle, N. Y.

Lathe Dogs
Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago, Ill.
Billings & Spencer Co., Hartford, Ct.
Efficiency Device Corp., Long Island City, N. Y.
Hammacher, Schlemmer & Co., Fourth Ave. and 13th St., New York.
Precision & Thread Grinder Mfg. Co., Philadelphia, Pa.
Ready Tool Co., 650 Railroad Ave., Bridgeport, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

Lathe Dogs, Safety
Bridgeport Safety Lathe Dog & Mch. Co., Bridgeport, Conn.
Efficiency Device Corp., Long Island City, N. Y.

Lathe, Planer and Shaper Tools
Armstrong Bros. Tool Co., 313 North Francisco Ave., Chicago, Ill.
Chard Lathe Co., Newcastle, Ind.
Federal Steel Co., Detroit, Mich.
Gisholt Mch. Co., 9 So. Baldwin St., Madison, Wis.
Lovejoy Tool Co., Inc., Springfield, Vt.
McCrosky Reamer Corp., Meadville, Pa.
O. K. Tool Holder Co., Shelton, Ct.
Pratt & Whitney Co., Hartford, Ct.
Ready Tool Co., 650 Railroad Ave., Bridgeport, Conn.
Sebastian Lathe Co., Cincinnati, O.
Thompson & Son Co., Henry G., New Haven, Conn.
Western Tool & Mfg. Co., Springfield, Ohio.
Williams & Co., J. H., 61 Richards St., Brooklyn, N. Y.

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Gisholt Mch. Co., 9 So. Baldwin St., Madison, Wis.
Jones & Lamson Mch. Co., Springfield Vt.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
National Acme Co., Cleveland, O.
New Britain Mchy. Co., New Britain, Conn.
Potter & Johnston Mch. Co., Pawtucket, R. I.
Reed-Prentice Co., Worcester, Mass.
Springfield Automatic Screw Machine Corp., Fitchburg, Mass.

Lathes, Automatic Screw Threading
Automatic Machine Co., Bridgeport, Conn.

Lathes, Axle
Betts Machine Co., Rochester, N. Y.
Fitchburg Machine Work, Fitchburg, Mass.
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Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Phila., Pa.

Lathes, Bench
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Dalton Mfg. Corp., Sound Beach, Ct.
Diamond Mch. Co., Providence, R. I.
Elgin Tool Works, Elgin, Ill.
Fairbanks Co., 416 Broome St., N. Y.
Goodell-Pratt Co., Greenfield, Mass.
Greenfield Tap & Die Corp., Greenfield, Mass.
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Hjorth Lathe & Tool Co., Boston, Mass.
Potter Tool & Mch. Works, S. A., 77 E. 130th St., New York.
Pratt & Whitney Co., Hartford, Ct.
Rivett Lathe & Grinder Co., Brighton, Boston, Mass.
Seneca Falls Mfg. Co., Inc., 381 Fall St., Seneca Falls, N. Y.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
Van Norman Mch. Tool Co., Springfield, Mass.

Lathes, Boring
Betts Machine Co., Rochester, N. Y.
Gisholt Mch. Co., 9 So. Baldwin St., Madison, Wis.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Philadelphia, Pa.
Wright, David A., 568 W. Washington Blvd., Chicago, Ill.

Lathes, Brass Workers'
Acme Machine Tool Co., Cincinnati, O.
Bardons & Oliver, Cleveland, O.
Dreses Machine Tool Co., Cincinnati, O.
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Seneca Falls Mfg. Co., Inc., 381 Fall St., Seneca Falls, N. Y.
Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.
Warner & Swasey Co., Cleveland, O.
Wood Turret Mch. Co., Brazil, Ind.

Lathes, Car Wheel
Betts Machine Co., Rochester, N. Y.
Manning Maxwell & Moore, Inc., 119 W. 40th St., New York.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Phila., Pa.

Lathes, Crankshaft
Betts Machine Co., Rochester, N. Y.
Manning Maxwell & Moore, Inc., 119 W. 40th St., New York.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Phila., Pa.

Lathes, Engine
Adams Mfg. Co., O. R., Rochester, N. Y.
American Tool Works Co., Cincinnati, Ohio.
Barnes Co., W. F. & John, Rockford, Ill.
Barnes Drill Co., Rockford, Ill.
Betts Machine Co., Rochester, N. Y.
Boye & Emmes Mch. Tool Co., Cincinnati, O.
Bradford Mch. Tool Co., Cincinnati, O.
Buckeye Drill & Lathe Co., Columbus, Ohio.
Champion Tool Works, 4955 Spring Grove Ave., Cincinnati, O.
Chard Lathe Co., Newcastle, Ind.
Cincinnati Lathe & Tool Co., Oakley, Cincinnati, O.
Cisco Mch. Tool Co., Cincinnati, O.
Dalton Mfg. Corp., Sound Beach, Ct.
Davis Mch. Co., C. F., Rochester, N. Y.
Davis Mch. Tool Co., Inc., Rochester, N. Y.
Farle Gear & Mch. Co., Phila., Pa.
Fairbanks Co., 416 Broome St., N. Y.
Flather & Co., Inc., Nashua, N. H.
Flather Mfg. Co., Nashua, N. H.
Giddings & Lewis Mch. Tool Co., Fond du Lac, Wis.
Gisholt Machine Co., 9 South Baldwin St., Madison, Wis.
Greaves-Klusman Tool Co., Cincinnati, O.
Greaves Mch. Tool Co., Cincinnati, O
Hamilton Mch. Tool Co., Hamilton, O.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago, Ill.
Hendey Mch. Co., Torrington, Conn.
Hill, Clarke & Co., Inc., Boston, Mass.
Houston, Stanwood & Gamble Co., Cincinnati, O.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Lehmann Mch. Co., 514 S. Broadway, St. Louis, Mo.
Lodge & Shipley Mch. Tool Co., Cincinnati, O.
Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York.
McCabe Lathe & Mchy. Corp., J. J., 149 Broadway, New York.
Monarch Mch. Tool Co., Sidney, O.
Morris Mch. Tool Co., Cincinnati, O
Mueller Mch. Tool Co., Cincinnati, O.
National Lathe Co., Cincinnati, O.
Niles-Bement-Pond Co., 111 Broadway, New York.
Oliver Machinery Co., Grand Rapids, Mich.
Pittsburgh Mch. Tool Co., Braddock, Pa.
Porter-Cable Mch. Co., Syracuse, N. Y.
Pratt & Whitney Co., Hartford, Ct.
Reed-Prentice Co., Worcester, Mass.
Rockford Lathe and Drill Co., Rockford, Ill.
Rockford Tool Co., 2502 Eleventh St., Rockford, Ill.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago, Ill.
Sebastian Lathe Co., Rockford, Ill.
Seneca Falls Mfg. Co., Inc., 381 Fall St., Seneca Falls, N. Y.
Sidney Mach. Tool Co., Sidney, O.
South Bend Lathe Works, South Bend, Ind.
Springfield Mch. Tool Co., Springfield, O.
Summit Mch. Works, Worcester, Mass.
Victor Lathe Co., 151 Lafayette St., New York.
Whitcomb-Blaisdell Mch. Tool Co., Worcester, Mass.
Willard Mch. Tool Co., Cincinnati, O.
Wright, David A., Chicago, Ill.

Lathes, Extension Bed and Gap
Barnes Drill Co., Inc., 814 Chestnut St., Rockford, Ill.
Fairbanks Co., 416 Broome St., N. Y.
Harrington, Son & Co., Inc., Edwin, Philadelphia, Pa.
Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York.
Sebastian Lathe Co., Cincinnati, O.

Lathes, Foot Power
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Fairbanks Co., 416 Broome St., N. Y.
Reed-Prentice Co., Worcester, Mass.
Seneca Falls Mfg. Co., Inc., 381 Fall St., Seneca Falls, N. Y.

Lathes, Gun Boring
Betts Machine Co., Rochester, N. Y.
LeBlond Machine Tool Co., R. K., Cincinnati, O.
Niles-Bement-Pond Co., 111 Broadway, New York.

Lathes, Patternmakers'
Blount Co., J. G., Everett, Mass.
Defiance Mch. Works, Defiance, O.
Oliver Machinery Co., Grand Rapids, Mich.
Seneca Falls Mfg. Co., Inc., 381 Fall St., Seneca Falls, N. Y.
Summit Mch. Works, Worcester, Mass.

Lathes, Pulley
Avey Drilling Mch. Co., Cincinnati, O.

Lathes, Shaft
Betts Machine Co., Rochester, N. Y.
Fitchburg Machine Works, Fitchburg, Mass.
Greaves Mch. Tool Co., Cincinnati, O.
Manning, Maxwell & Moore, Inc., 119 W. 40th St., New York.
Niles-Bement-Pond Co., 111 Broadway, New York.
Sellers & Co., Inc., Wm., Phila., Pa.

Lathes, Speed
Blount Co., J. G., Everett, Mass.
Diamond Mch. Co., Providence, R. I.
Fairbanks Co., 416 Broome St., N. Y
Greenfield Tap & Die Corp., Greenfield, Mass.
Oliver Mchy. Co., Grand Rapids, Mich
Potter Tool & Mch. Works, S. A., 77 E. 130th St., New York.
Summit Mch. Works, Worcester, Mass.

Lathes, Turret
See also Chucking Machines.
Acme Mch. Tool Co., Cincinnati, O.
Bardons & Oliver, Cleveland, O.
Betts Machine Co., Rochester, N. Y
Brown & Sharp Mfg. Co., Providence, R. I.
Bullard Mch. Tool Co., Bridgeport, Conn.
Davis Machinery Tool Co., Inc., Rochester, N. Y.
Dreses Mch. Tool Co., Cincinnati, O.
Foster Machine Tool Co., Elkhart, Ind.
Garvin Mch. Co, Spring and Varick Sts., New York.
Gisholt Mch. Co., 9 So. Baldwin St., Madison, Wis.
Greaves-Klusman Tool Co., Cincinnati, Ohio.
Greaves Mch. Tool Co., Cincinnati, O
Herbert Ltd, Alfred, 54 Dey St., New York.
International Machine Tool Co., Indianapolis, Ind.
Jones & Lamson Mch Co., Springfield, Vt.
Le Blond Mch. Tool Co., R. K., Cincinnati, O.
Lodge & Shipley Machine Tool Co., Cincinnati, O.
Morris Mch. Tool Co., Cincinnati, O.
New Britain Machine Co., New Britain, Conn.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pratt & Whitney Co., Hartford, Conn.
Oliver Machinery Co., Grand Rapids, Mich.
Reed-Prentice Co., Worcester, Mass.
Rivett Lathe & Grinder Co., Brighton, Boston, Mass.
Springfield Mch. Tool Co., 631 Southern Ave., Springfield, O.
Steinle Turret Mch. Co., Madison, Wis.
Warner & Swasey Co., Cleveland, O.
Wood Turret Mch. Co., Brazil, Ind.

Lathes, Woodworkers'
Barnes Co., W. F. & John, 231 Ruby St., Rockford, Ill.
Defiance Mch. Works, Defiance, O.
Fairbanks Co., 416 Broome St., N. Y.
Oliver Machinery Co., Grand Rapids, Mich.
Reed-Prentice Co., Worcester, Mass.

Leather Belting, Round
See Belting, Round Leather.

Levels
Dietzgen Co., Eugene, 166 W. Monroe St., Chicago, Ill.
Keuffel & Esser Co., Hoboken, N. J.
New York Blue Print Paper Co., 102 Reade St., New York.
Rieker Instrument Co., Phila., Pa.
Starrett Co., L. S., Athol, Mass.

Lighting Fixtures, Adjustable
Breeze Mfg. Co., Newark, N. J.
Manufacturing Equipment & Engineering Co., Framingham, Mass.

Lubricants
Besly & Co., Chas. H., 120-B N. Clinton St., Chicago, Ill.
Dixon Crucible Co., Joseph, Jersey City, N. J.
Fiske Bros. Refining Co., 24 State St., New York.
Lumen Bearing Co., Buffalo, N. Y.
Oakley Chemical Co., 26 Thames St., New York.
Royersford Foundry & Mch. Co., 54 N. 5th St., Philadelphia, Pa.
Sun Company, Philadelphia, Pa.
Swan & Finch Co., 522 Fifth Ave., New York.
Texas Co., 17 Battery Place, N. Y.

Lubricators
Besly & Co., Chas. H., 120-B N. Clinton St., Chicago, Ill.
Bowen Products Corp., Auburn, N. Y.
Greene, Tweed & Co., 109 Duane St., New York
Michigan Lubricator Co., Detroit, Mich.

Machinists' Small Tools
See Calipers, Hammers, Wrenches, Drills, Taps, etc.

Mallets, Rawhide
Chicago Rawhide Mfg. Co., 1301 Elston Ave., Chicago, Ill.

Mandrels, Expanding and Solid
See Arbors and Mandrels, Expanding and Solid.

Marking Machines
Grant Mfg. & Mch. Co., N. W. Station, Bridgeport, Conn.
Noble & Westbrook Mfg. Co., Hartford, Conn.
V & O Press Co., Glendale, Long Island, N. Y.

Measuring Machines, Precision
Golden Co., 405 Lexington Ave., N. Y.
Herbert Ltd, Alfred, 54 Dey St., New York.
Johansson, Inc., C. E., Poughkeepsie, N. Y.
Pratt & Whitney Co., Hartford, Ct.
Rogers Works, J. M., Gloucester City, N. J.
Taft-Peirce Mfg. Co., Woonsocket, R. I.

Metals, Bearing
See Bearings, Bronze, Babbit, etc., and Bushings, Brass, Bronze, etc.

Metals, Perforated
Chicago Perforating Co., 244 W. 24th Place, Chicago, Ill.

Milling and Drilling Machines, Upright
See Drilling and Milling Machines, Vertical.

Milling and Shaping Machines
Cochrane-Bly Co., Rochester, N. Y.

Milling Attachments
Adams Co., Dubuque, Iowa.
Bath & Co., Inc., John, Worcester, Mass.
Becker Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Clark-Mesker Co., Cleveland, O.
Cleveland Milling Machine Co., Cleveland, O.
Fairbanks Co., 416 Broome St., N. Y.
Garvin Mch. Co., Spring and Varick Sts., New York.
Hendey Mch. Co., Torrington, Conn.
Hinckley Mch. Works, Hinckley, Ill.
Ingersoll Milling Mch. Co., Rockford, Ill.
Kearney & Trecker Co., Milwaukee, Wis.
Kempsmith Mfg. Co., Milwaukee, Wis.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Oesterlein Mch. Co., Cincinnati, O.
Porter-Cable Mch. Co., Syracuse, N. Y.
Pratt & Whitney Co., Hartford, Conn.
Rivett Lathe & Grinder Co., Brighton, Boston, Mass.
Rockford Milling Mch. Co., Rockford, Ill.
Standard Engineering Works, Pawtucket, R. I.
Whitney Mfg. Co., Hartford, Conn.

Milling Machines, Automatic
Brown & Sharpe Mfg. Co., Providence, R. I.
Fairbanks Co., 416 Broome St., N. Y.
Pratt & Whitney Co., Hartford, Ct.

Milling Machines, Bench
Ames Co., B. C., Waltham, Mass.
Burke Machine Tool Co., 516 Sandusky St., Conneaut, O.
Carter & Hakes Co., Sterling Place, Winsted, Conn.
Greenfield Tap & Die Corp., Greenfield, Mass.
Hardinge Bros., Inc., Berteau and Ravenswood Aves., Chicago, Ill.
Rockford Milling Mch. Co., Rockford, Ill.
Sloan & Chace Mfg. Co., Ltd., Newark, N. J.
Van Norman Mch. Tool Co., Waltham Ave., Springfield, Mass.

Milling Machines, Circular Continuous
Becker Milling Mch. Co., Hyde Park, Mass.
Kearney & Trecker Co., Milwaukee, Wis.
Gould & Eberhardt, Newark, N. J.

Milling Machines, Hand
Becker Milling Mch. Co., Hyde Park, Mass.
Bristol Mch. Tool Co., Bristol, Conn.
Burke Machine Tool Co., 516 Sandusky, St., Conneaut, O.
Carter & Hakes Co., Sterling Place, Winsted, Conn.
Clark-Mesker Co., Cleveland, O.
Defiance Mch. Works, Defiance, O.
Garvin Mch. Co., Spring and Varick Sts., New York.

ALPHABETICAL INDEX TO ADVERTISERS, PAGES 555-556.

Le Blond Rapid Production Lathes on Remy Ignition



From One Machine to Two Dozen in Less Than Three Years

We are indebted to the Remy Electric Company, Anderson, Ind., for the facts and photographs. The pictures, taken in this company's production department, show the commutator end of a motor-cycle generator frame being turned and faced, also a "before and after" close-up view of the work.

Length of the turned section is 1 5/16", its diameter not less than 3.552" or more than 3.557". Material is malleable iron and the floor-to-floor time four minutes to each piece. The Rapid Production Lathe has carried a SPEED UP message to the Remy Shops. The instantaneous start and stop to spindle, the Heavy Duty Bed section, the box section apron with positive feed clutch, and the increased power and convenience factors have enabled it to MAKE GOOD.

The R.K.Le Blond Machine Tool Co.

Cincinnati.Ohio.

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Standard Engineering Works, Pawtucket, R. I.
Van Norman Mch. Tool Co., Waltham Ave., Springfield, Mass.
Whitney Mfg. Co., Hartford, Conn.

Milling Machines, Horizontal, Plain
Beaman & Smith Co., Providence, R.I.
Becker Milling Mch. Co., Hyde Park, Mass.
Bilton Mch. Tool Co., Bridgeport, Ct.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mch. Co., Oakley, Cincinnati, O.
Clark-Mesker Co., Cleveland, O.
Defiance Mch. Works, Defiance, O.
Fairbanks Co., 416 Broome St., N. Y.
Fox Machine Co., Jackson, Mich.
Gabrielson Mfg. Corp., Syracuse, N. Y.
Garvin Mch. Co., Spring and Varick Sts., New York.
Gooley & Edlund, Inc., Cortland, N. Y.
Hendey Machine Co., Torrington, Ct.
Herbert Ltd, Alfred, 54 Dey St., New York.
Ingersoll Milling Mch. Co., Rockford, Ill.
Kearney & Trecker Co., Milwaukee, Wis.
Kempsmith Mfg. Co., Milwaukee, Wis.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Newton Machine Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Oesterlein Mch. Co., Cincinnati, O.
Pratt & Whitney Mfg. Co., Hartford, Conn.
Rockford Milling Mch. Co., Rockford, Ill.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago, Ill.
Standard Engineering Works, Pawtucket, R. I.

Milling Machines, Horizontal, Universal
Becker Milling Machine Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mch. Co., Oakley, Cincinnati, O.
Clark-Mesker Co., Cleveland, O.
Defiance Mch. Works, Defiance, O.
Fairbanks Co., 416 Broome St., N. Y.
Hendey Mch. Co., Torrington, Conn.
Herbert Ltd, Alfred, 54 Dey St., New York.
Kearney & Trecker Co., Milwaukee, Wis.
Kempsmith Mfg. Co., Milwaukee, Wis.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Niles-Bement-Pond Co., 111 Broadway, New York.
Oesterlein Mch. Co., Cincinnati, O.
Rockford Milling Mch. Co., Rockford, Ill.
Rowbottom Mch. Co., Waterbury, Ct.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago, Ill.
Van Norman Mch. Tool Co., Waltham Ave., Springfield, Mass.

Milling Machines, Lincoln Type
Beaman & Smith Co., Providence, R. I.
Becker Milling Mch. Co., Hyde Park, Mass.
Brown & Sharpe Mfg. Co., Providence, R. I.
Gabrielson Mfg. Corp., Syracuse, N. Y.
Garvin Mch. Co., Spring and Varick Sts., New York.
Hendey Machine Co., Torrington, Ct.
Kempsmith Mfg. Co., Milwaukee, Wis.
Pratt & Whitney Co., Hartford, Conn.
Reynolds Mch. Co., Massillon, O.
Van Norman Mch. Tool Co., Waltham Ave., Springfield, Mass.

Milling Machines, Multiple Spindle
Beaman & Smith Co., Providence, R.I.
Ingersoll Milling Mch. Co., Rockford, Ill.
Newton Mch. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.

Milling Machines, Oscillating Head
Superior Mch. & Engineering Co., Detroit, Mich.

Milling Machines, Portable
Newton Mch. Tool Works, Inc., Philadelphia, Pa.
Pedrick Tool & Mch. Co., 3639 North Lawrence St., Philadelphia, Pa.
Underwood Corp., H. B., Phila., Pa.

Milling Machines, Spline
Lees-Bradner Co., Cleveland, O.
Pratt & Whitney Co., Hartford, Ct.
Standard Eng. Works, Pawtucket, R. I.
Taylor & Fenn Co., Hartford, Conn.

Milling Machines, Vertical
Beaman & Smith Co., Providence, R.I.
Becker Milling Mch. Co., Hyde Park, Mass.
Bristol Mch. Tool Co., Bristol, Ct.
Brown & Sharpe Mfg. Co., Providence, R. I.
Cincinnati Milling Mch. Co., Oakley, Cincinnati, O.
Cochrane-Bly Co., Rochester, N. Y.
Fairbanks Co., 416 Broome St., N. Y.
Garvin Mch. Co., Spring and Varick Sts., New York.
Herbert Ltd, Alfred, 54 Dey St., New York.
Ingersoll Milling Mch. Co., Rockford, Ill.
Kearney & Trecker Co., Milwaukee, Wis.
LeBlond Mch. Tool Co., R. K., Cincinnati, O.
Newton Mch. Tool Works, Inc., Philadelphia, Pa.
Niles-Bement-Pond Co., 111 Broadway, New York.
Pratt & Whitney Co., Hartford, Conn.
Ryerson & Son, Joseph T., 2558 W. 16th St., Chicago, Ill.
Van Norman Mch. Tool Co., Waltham Ave., Springfield, Mass.

Milling Tools, Hollow Adjustable
Geometric Tool Co., New Haven, Conn.
Rogers Works, Inc., J. M., Gloucester City, N. J.

Model and Experimental Work
See Special Machinery and Tools.

Molding Machines
Adams Co., Dubuque, Iowa.
Hanna Engineering Works, 1763 Elston Ave., Chicago, Ill.

Motors, Electric
Dillon Electric Co., Canton, O.
Electro Dynamic Co., Bayonne, N. J.
Fairbanks Co., 416 Broome St., N. Y.
General Elec. Co., Schenectady, N. Y.
Reliance Elec. and Engineering Co., 1056 Ivanhoe Road, Cleveland, O.
Wagner Electric Mfg. Co., St. Louis, Mo.
Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

Name Plates, Cast Bronze
Matthews & Co., Jas. H., Pittsburgh, Pa.
Newman Mfg. Co., Cincinnati, O.
Pannier Bros. Stamp Co., Pittsburgh, Pa.
Schwerdtle Stamp Co., Bridgeport, Ct.

Name Plates, Etched
Matthews & Co., Jas. H., Pittsburgh, Pa.
Newman Mfg. Co., Cincinnati, O.
Noble & Westbrook Mfg. Co., Hartford, Conn.
Pannier Bros. Stamp Co., Pittsburgh, Pa.
Schwerdtle Stamp Co., Bridgeport, Ct.

Name Plates, Stamped
Matthews & Co., Jas. H., Pittsburgh, Pa.
Newman Mfg. Co., Cincinnati, O.
Noble & Westbrook Mfg. Co., Hartford, Conn.
Pannier Bros. Stamp Co., Pittsburgh, Pa.
Schwerdtle Stamp Co., Bridgeport, Ct.

Nichrome Castings
Driver-Harris Co., Harrison, N. J.

Nipple Threading Machinery
Bignall & Keeler Machine Works, Edwardsville, Ill.
Landis Mch. Co., Inc., Waynesboro, Pa.
Merrell Mfg. Co., 15 Curtis St., Toledo, Ohio.
Murchey Mch. & Tool Co., 34 Porter St., Detroit, Mich.
Saunders Sons, D., Yonkers, N. Y.
Standard Eng. Works, Pawtucket, R. I.

Nut Castellating Machines
Craftsman Tool Co., Conneaut, O.

Nuts, Castellated
National Acme Co., Cleveland, O.

Nut Tappers
See Bolt and Nut Machinery.

Odometers
Veeder Mfg. Co., 39 Sargeant St., Hartford, Conn.

Oil Cups
American Galco Co., Inc., Grand Central Palace, New York.
Besly & Co., Charles H., 120-B North Clinton St., Chicago, Ill.
Bowen Products Corp., Auburn, N. Y.
Gits Bros. Mfg. Co., 1901 South Kilbourne Ave., Chicago, Ill.
Michigan Lubricator Co., Detroit, Mich.
Purves Mfg. Co., Syracuse, N. Y.
Tucker, W. M. & C. F., Hartford, Ct.

Oilers
American Galco Co., Inc., Grand Central Palace, New York.
Gem Mfg. Co., Pittsburgh, Pa.

Oilers, Loose Pulley
Brown Engineering Co., 133 N. 3rd St., Reading, Pa.
Michigan Lubricator Co., Detroit, Mich.

Oil Extractors
Tolhurst Mch. Works, Troy, N. Y.

Oil Gages
Michigan Lubricator Co., Detroit, Mich.

Oil Hole Covers
Bowen Products Corp., Auburn, N. Y.
Gits Bros. Mfg. Co., 1901 So. Kilbourne Ave., Chicago, Ill.
Tucker, W. M. & C. F., Hartford, Ct.

Oil Pans, Sheet Steel
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Oils, Lubricating
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Reichhelm & Co., E. P., 24 John St., New York.

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Oxy-Acetylene Apparatus
See Welding and Cutting, Oxy-Acetylene Equipment.

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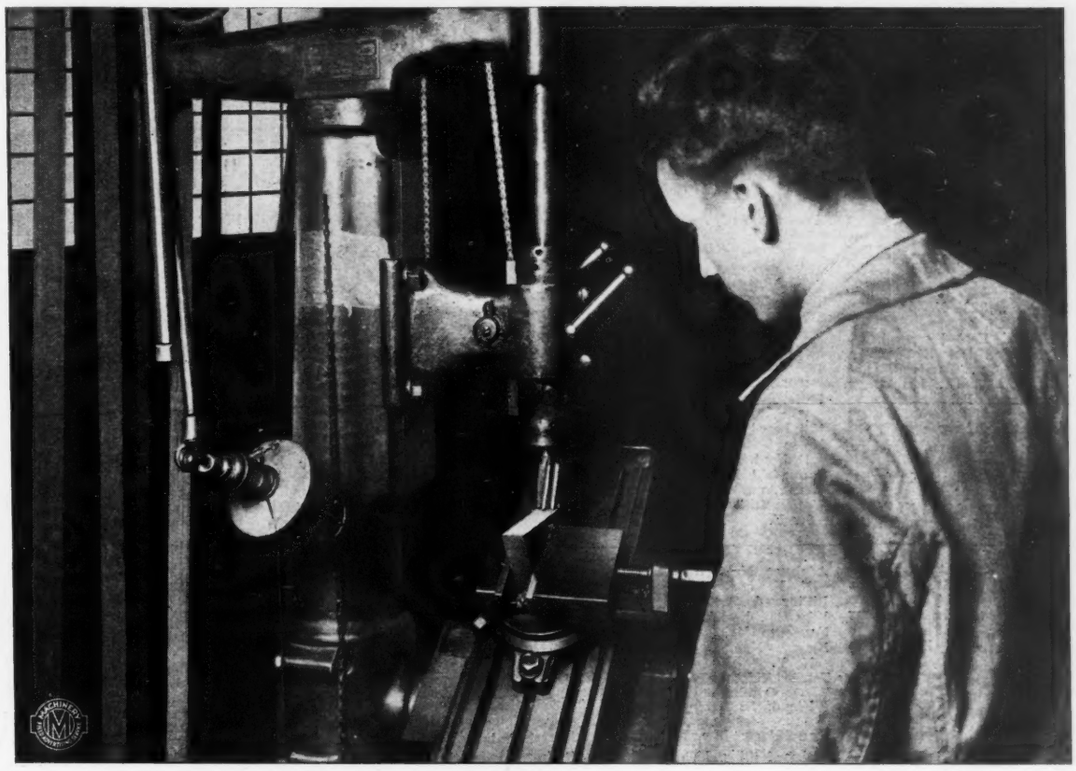
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KNIGHT

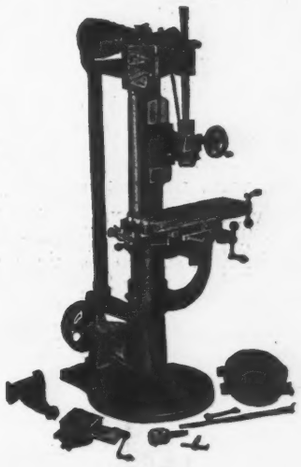
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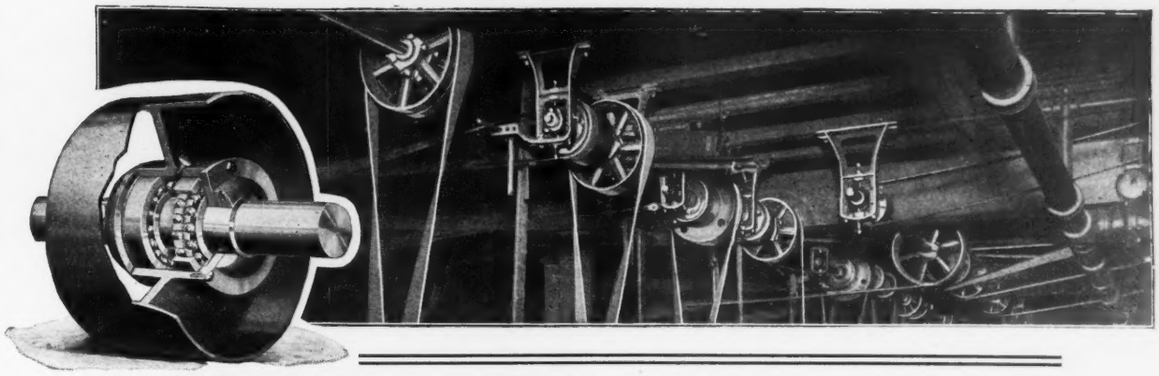
Reamers, Aligning

Taft-Peirce Mfg. Co., Woonsocket, R. I.

Reamers, Bearing Alignment

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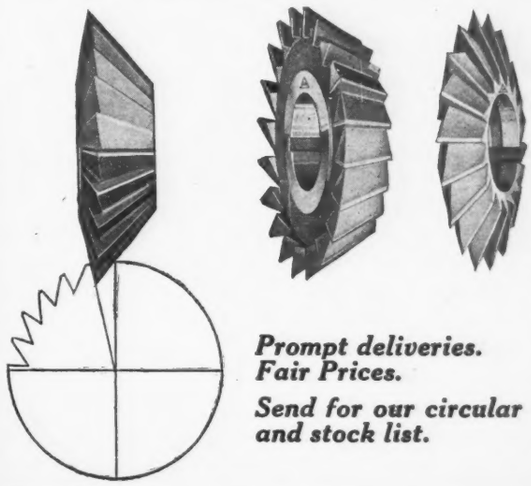
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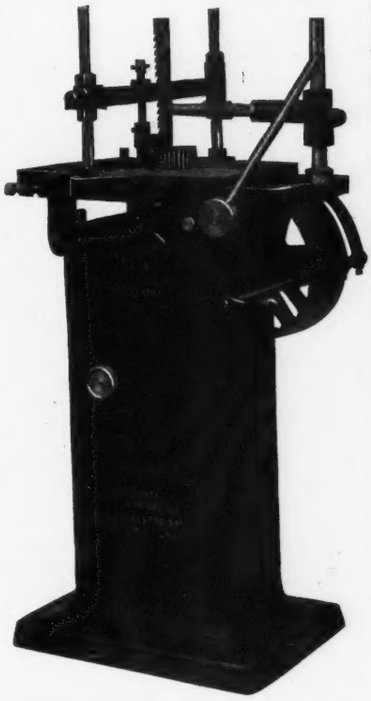
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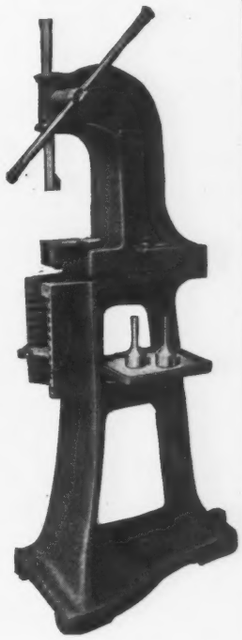
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Sellers & Co., Inc., Wm., Phila., Pa.

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Niles-Bement-Pond Co., 111 Broadway, New York.

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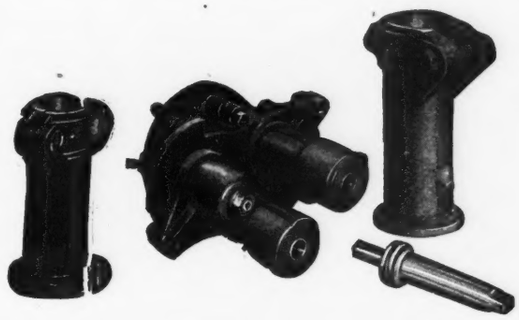
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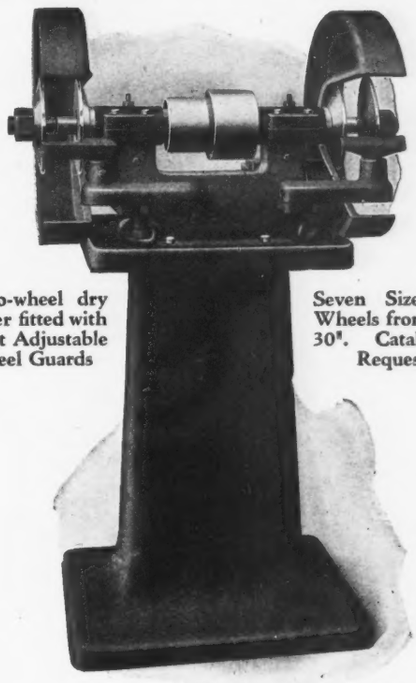
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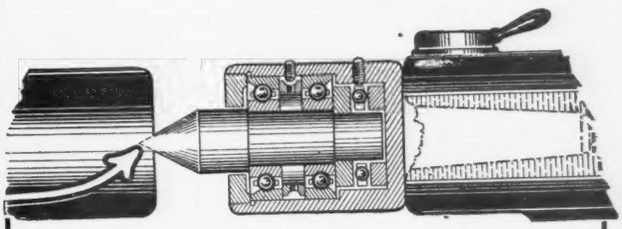
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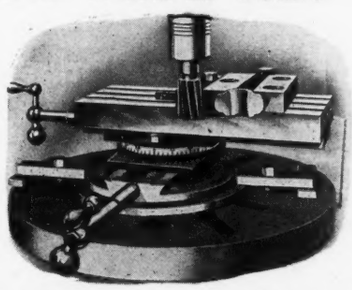
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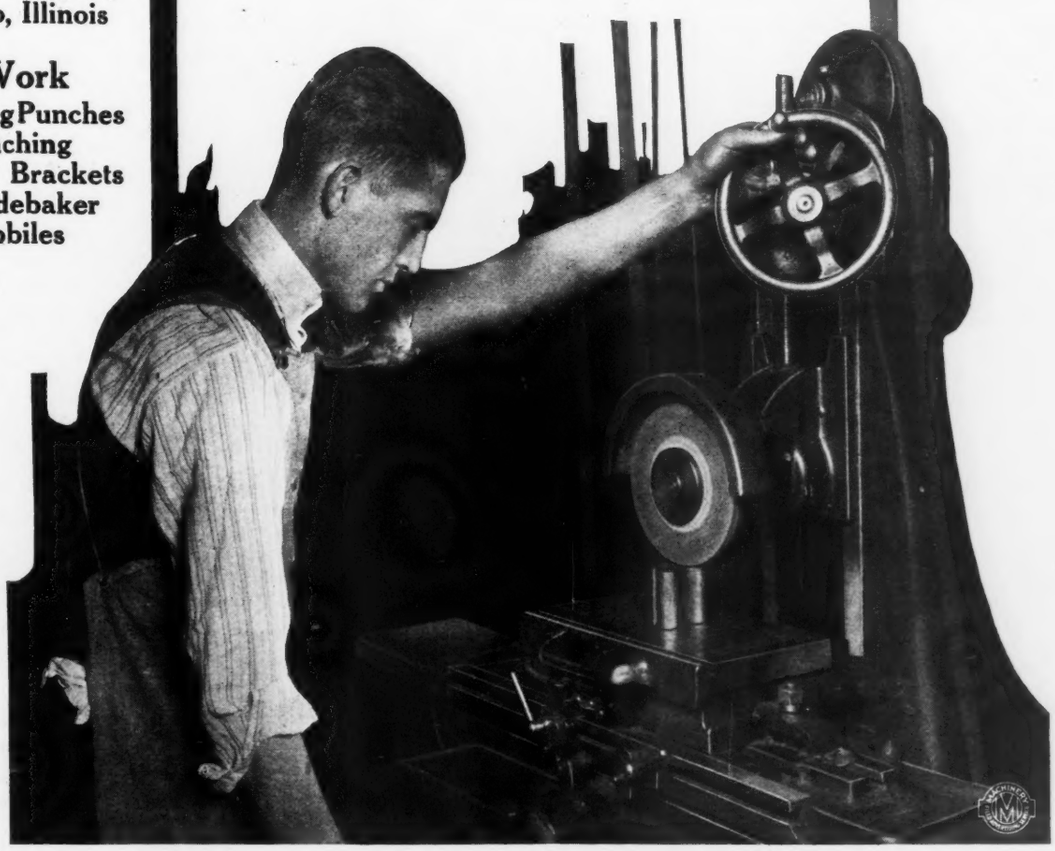
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The CATARACT Bench Lathe

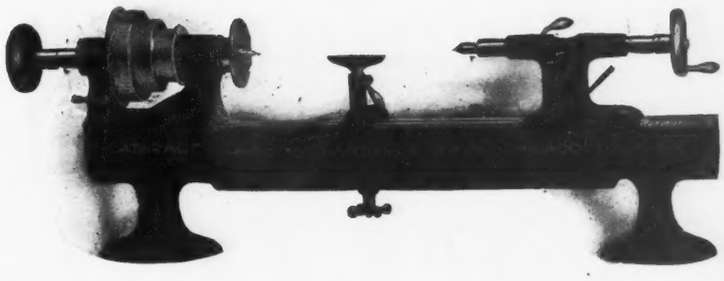
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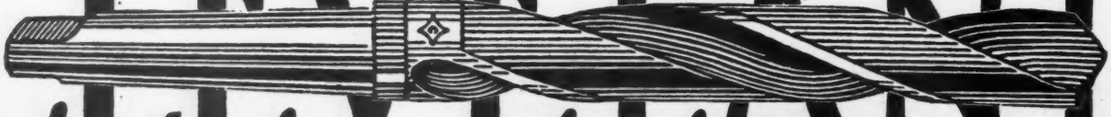
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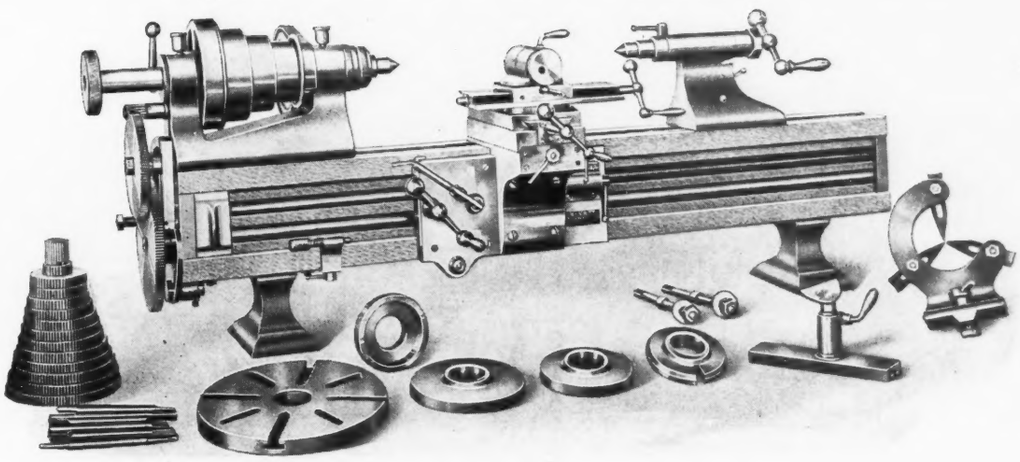
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